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Our Description of Machinery Show at Paris.

Some enquiries we have received lead us to conclude that it may be useful to explain our plan in regard to illustrating and describing the machinery shown at Paris. In the first place, it seemed necessary to confine our treatment to those things that can be classed as machine shop equipment. There is so much other machinery there that to illustrate all of it would be an endless task likely to exhaust the patience of our readers, and we therefore chose that class of machinery in which they are nearly all interested—*i. e.*, machinery used in the conduct of machine shops.

Then within this class we must of course make some selection. It would obviously be absurd for us to illustrate and describe machines that we have previously fully presented, just because those machines are now exhibited at Paris, and to print, as so many of our esteemed contemporaries are doing, a list or catalog of those exhibits made by their advertisers or those who they hope will advertise, and so keep repeating through many wearisome paragraphs changes rung upon the formula that runs: "The well-known firm of Pygg, Ierone & Co. show a variety of sizes of their famous sausage grinders with compound stuffing attachment, which have made the name of Pygg, Ierone & Co. a household word throughout the land," would not be creditable, and would be exceedingly wearisome to us and our readers.

We are attempting to give as good an idea as possible of what is shown at Paris in the way of machine shop equipment that is really new and interesting. To do this as it should be done we of course require the co-operation of builders of the various machines to the extent of answering our questions about them and supplying us with photographs, blueprints, etc., from which we can make engravings. In some cases we fail, or at least have so far failed, to secure this co-operation, some exhibitors seeming to entertain the rather queer idea that their machines exhibited at Paris have secrets of construction about them that it will not do to impart to other machinists, and somehow they expect to go on selling these machines to machinists everywhere and still maintain their secrets about them. However, we shall, before we finish, be able to give an intelligible account of most of what is shown that is of real interest.

Poleforcia.

We have received from several of our friends located in different parts of the country pamphlets which are supposed to describe "poleforcia," which we are told is the "name of a new power produced by the multiple energising momentum engine." These pamphlets hail from London, though it would appear from pamphlet No. 3, which is before us, that the enterprise was started in Camden, N. J., where an engine was built and exhibited. The scornful, however, considered that "the great Power, shown by these Engines, was pumped up for a couple of weeks, before the exhibition, or that the Electric light shown, came from a wire through the fence; anywhere else except from the Engine itself, a mere get-up to sell stock." In consequence of such unkindness the sensitive "Owners of the Multiple Energising Momentum Engine have been compelled to entrust the construction of the Engine to a British Firm, so as to avoid the allegation of fraud which might have been made had the Engine been built in America (where the Keely Motor swindle has been so successful)." It will be seen that the owners require their engine, as Caesar required his wife, to be above suspicion.

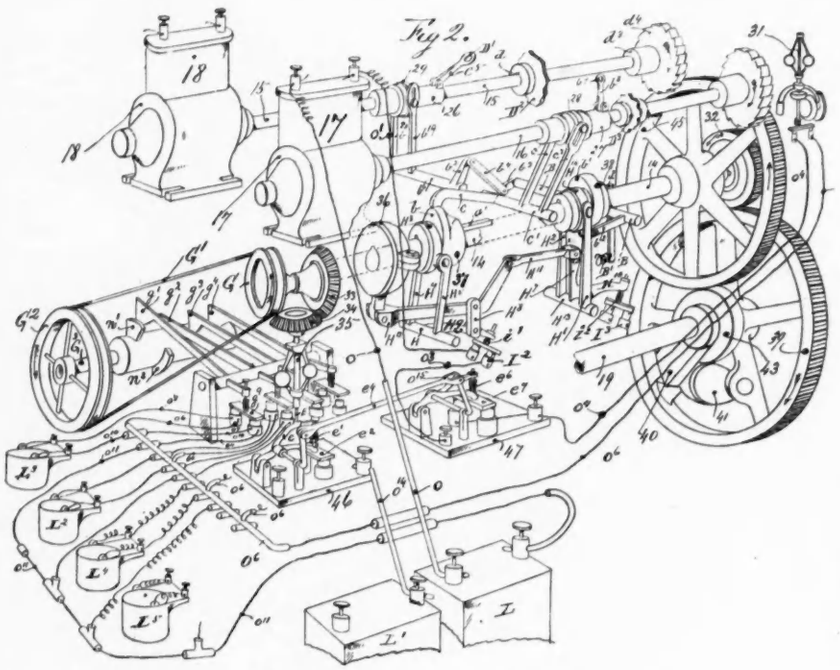
The language of these pamphlets is of a type in which such things are usually clothed, and it may be described as "sound and fury signifying nothing." As gems of explanatory and descriptive language we commend the following to our readers:

"There appears to be the following prevalent misconception in regard to Power, viz., that it is not possible to have Power without Heat, or Heat without Power. Yet our discovery shows that Power can be obtained with little or no Heat. It is unnecessary to here allude to the other erronious theory of Power (Energy) being the same as Matter, for the reasons set forth in our Pamphlet No. 2," though what connection "Power without Heat" or the "other erronious theory of Power" has to do with the subject in hand is too much for us. The forerunner of the Multiple Energising Momentum Engine was a Car Starter by the same inventor, of which we are told, "Thus Traction was made, the small wheels supporting the car running down a constantly manufactured incline plane, the car being propelled by the action of gravity, in this way *Gravity extracting the Fulcrum.*"

When we arrive at the consideration of the new power, we are told: "Here we have a startling discovery, viz., the direct production of Power obtained by taking advantage of the well-known mechanical Laws of Traction and Rotary Momentum so as to cause a multiplication of Power by Acceleration."

Now what is all this about? For reply we go to United States patent No. 600,446, issued March 8, 1898, and we find what we hope is the most remarkable document which ever received the seal of the Patent Office. This paper contains nine pages of the most fearfully and wonderfully conceived illustrations, to the number of twenty-four, that we have ever seen, with eight and a half pages of specifications and claims in the same verbose, head-in-the-clouds language as the pamphlet already quoted from, and which we will defy anyone in or out of the Patent Office to read and understand. Summed up, the great

"invention" consists of several engines or motors, each having a flywheel connected by a clutch to a common driven shaft. The flywheels are disconnected from the driven shaft in turn, and their motion is then accelerated by their engines. When a given speed is reached by each flywheel, it is connected to the driven shaft, and, by its momentum, it drives the shaft until its speed has been reduced to a lower limit, when it is again disconnected and its speed again accelerated—another wheel meanwhile being connected to the driven shaft. We scarcely know which to admire more—the beauty of this conception or the elegant simplicity of the mechanism in which it is embodied, and we therefore give our readers an opportunity to



THE MULTIPLE ENERGISING MOMENTUM ENGINE.

judge for themselves by reproducing herewith Fig. 2 of the patent drawings.

While such things pass the Patent Office can we wonder that so many scoff at the examinations made by the office? Knowing something of the very intelligent nature of this examination in many cases, we are at a loss to account for this on any other assumption than that the examiner passed the papers in sheer weariness and desperation. None the less the specification shows clearly the fog surrounding the inventor's brain (the papers were drawn by the inventor) and that he believes he has produced a machine which manufactures power. If our readers desire to see what is perhaps the greatest curiosity that ever received the seal of the United States Government, we advise them to obtain a copy of this patent. There are other illustrations in it that are worth seeing as curiosities, although we reproduce the gem of the lot. We think this is essentially a patent on a perpetual motion scheme.

The Generation of Intense Heat by the Combustion of Aluminum and its Application in Metallurgical Operations.

S. B. Archdeacon has written for "The Engineering and Mining Journal" an interesting account of the process of Dr. Hans Goldschmidt, of Essen-Ruhr, Germany, for the generation of intense heat by the combustion of aluminum and its application in various metallurgical operations, of which the most valuable and practical to us are the welding of iron pipes, rails, etc., the repairing of castings or the local additions of metal wherever required. It has been found impossible to measure accurately the temperature generated, but it is estimated to be about 3,000 degrees Centigrade, or 5,432 Fahrenheit. As a result of the simplicity of the process now perfected, and on account of the constantly decreasing price of aluminum during the last few years, it is possible to apply at a small cost a heat of an intense nature, at any required spot, without the aid of machinery or costly apparatus.

The heating agent, consisting chiefly of powdered aluminum and oxide of iron, has been patented and registered in all industrial countries under the name of "Thermit." It is practically smokeless, and emits, when burning, no noxious fumes. It is not subject to spontaneous combustion, but slightly deteriorates in calorific power when exposed to a moist atmosphere. For the whole operation nothing more is required than a slag-lined fireclay crucible, a pair of tongs, a clamp, the necessary "thermit" and a box of matches; the total weight of the outfit being about 50 pounds for pipes up to 4 inches diameter.

Repeated experiments and trials have proved that the weld is capable of withstanding a pressure of up to 400 atmospheres against some 100 atmospheres with an ordinary flange or socket joint. Further experiment showed that on hammering the longitudinal weld split or cracked before the transverse weld gave indication of alteration; also, that the pipes could be bent to almost any angle without disturbing the weld connection. On drawing in a cold state, the pipes invariably broke at a spot other than the transverse weld. As before mentioned, the cost is less than that of a flange or good socket joint, especially so where a high pressure has to be withstood; a 2½-inch pipe costing from 60 to 75 cents, profit included, against about $1.20 for a good flange. This sum, which includes crucible, mold and labor, is considerably reduced should a larger number of welds be made at one time. It is a simple matter to saw the pipe and weld in a piece where a connection is found necessary for any alteration, a proceeding taking little more time than the removal of rusty flanges.

The pipes to be welded, after filing the faces to remove dirt or rust, are pressed together by clamps. A mold of sheet iron is fixed underneath and around the joint as a receptacle for the thermit. It is surrounded with molding sand to prevent accident and leakage. The thermit is then ignited, a crucible of a capacity corresponding to the size of the pipe being used. The white-hot fluid is then poured into the sheet-iron mold, until the joint is entirely surrounded by the molten mass. Immediately on the solidification of the surface a little sand is added to keep in the heat. The requisite welding heat for, say, a 2½-inch pipe is imparted in about 1½ minutes; then the clamps are shortened a little in addition to the expansion by the heat forcing the ends together, and the mold is complete. The pipe is then allowed to cool, the clamps and the mold are removed and the solidified slag and regulus are detached by a slight blow with a hammer.

"The idea would evidently occur to many that on pouring the contents of the crucible upon the tubes, the molten iron would immediately attach itself to the same on account of its high temperature. That this is not the case will be readily understood from the following explanation. In the crucible are two separate and distinct fluids, the molten regulus below and the alumina or slag on top. On emptying the crucible the molten alumina is first poured on to the joint and as it solidifies to a slight extent immediately on coming into contact with the cold iron, a refractory layer or lining is formed, which effectively resists the heat of the molten regulus and prevents it from attaching itself to the pipes. In like manner a refractory layer of molten alumina is formed upon the sheet-iron mold, preserving the same

from being quickly destroyed, so that it may be used many times."

The process of welding rails is similar to that for pipes, stronger clamps and larger quantities of the thermit being used on account of the greater thickness of the metal.

"The application of the process for repairing cracked steel castings is of particular importance, as many castings that would formerly have been discarded can be rendered sound and serviceable at a very slight expense. As it is possible to produce by the process an iron or steel of any composition that may be required, the repaired spot on the casting can be made, if necessary, of a structure and quality corresponding to the body. The method of procedure is similar to that before described, a small sheet-iron form surrounded by molding sand being arranged as the conditions allow, to hold the molten regulus. After first pouring away the molten slag, the regulus is rapidly poured on to the fault and the whole is gradually allowed to cool before removal of the mold. For complicated repairs, it is better to take, in place of the sheet-iron mold, a properly prepared and adjusted form of clay or other suitable material, in order to prevent any leakage."

Closing of Old Locomotive Works.

It is announced that the Rogers Locomotive Works, Paterson, N. J., are to be permanently closed as soon as work now in hand is completed, which it is expected will be about December 1, and about 1,500 hands must find employment elsewhere. John Clark, of Paisley, Scotland, started an iron works upon part of the site of the locomotive works in 1800. For many years the shops were driven by water power. Thomas Rogers was a carpenter in the employ of Clark; in 1810 he became a member of a firm organized to carry on the works, and the Rogers family has since furnished the principal owners. The main business for many years was in cotton-mill machinery. The first locomotive was built in 1852, and since then engines have been sent from the works all over the Union and to most of the foreign countries. The works must always have been operated at more or less of a disadvantage, as there was no railroad connection, and the locomotives, when finished, were hauled by horses through the streets, which meant also that all material and supplies had to be hauled and handled expensively. The tools and equipment of the works are of course now far out of date, so that a heavy expense would be involved in re-equipment and reorganization. Robert S. Hughes, the president of the company, died a month ago, and Jacob Rogers, the principal owner, is old and has not taken an active part in the business for ten years. The affairs will be closed up by the vice-president, George H. Longbottom. As there is plenty of work, and as it has not been unprofitable under existing conditions, it would seem to an outsider that re-organization and re-equipment would be preferable to annihilation.

Since the above was written the merchants and business men of Paterson have been moved to take action in the matter. Mr. Rogers has been interviewed, and is reported as follows:

"I do not insist that the works shall close. I simply wanted to get out myself, and saw no way to do it but to wind up the affairs of the concern. If the business men of Paterson wish to buy me out, and will make me any kind of a proposition, I will meet them more than half way. I have been in the business all my life. I am growing old, and have all the money I want. I have tried to do no business for the last seven years, but so long as I hold the greater part of the stock of the company I must look after the business more or less. The works pay, and pay well. They are turning out now about twenty locomotives a month. There is from $1,000 to $1,500 profit on each finished machine. That is a good return. With improved machinery, which is needed, the output could be increased and profits increased per engine.

"If the business men of this city want to take over the works it ought to be easy for them to do so. I estimate that the cost of needed improvements and working capital would be $300,000, or, perhaps to be safe, say, $400,000. As for the stock there need be no money raised. Bonds could be issued to cover the stock and material and machinery, and the bonds could be easily handled. I would make easy terms."

A public meeting is to be held by those interested soon. The Board of Trade will probably hold a special meeting to consider the matter.

Legal Notes.

BY WM. MARSTON SEABURY.

NEGLIGENCE OF "FELLOW SERVANTS."

Charles Sofield was employed by the Guggenheim Smelting Company in its copper smelting factory at Perth Amboy, N. J., as a helper. Near the furnace where Sofield worked other workmen were engaged in taking from another furnace molten copper, and throwing it with ladles into a pit of cold water (which by this process became hot) some 15 feet away. The pit when not in use was covered with planking furnished by the company, the purpose of which was to prevent anyone falling into it. During the progress of the work, and in the middle of the night a recess was taken by the men, who failed to replace the boards over the pit. Sofield was sent on an errand by the foreman, and in going along a passageway beside the pit to a door at the end of the factory he slipped or fell into the pit, and was so badly scalded that in a few days he died from the injuries he received. His administratrix, Nellie Sofield, brought suit in the Supreme Court of New Jersey to recover damages for his death, and was awarded a verdict and judgment in her favor.

The defendant appealed to the Court of Errors and Appeals upon the ground that the court had erred in refusing to dismiss the plaintiff's suit, and also for not directing the jury to render a verdict for the defendant.

The appellate court, Mr. Justice Lippincott writing the opinion, held that the workmen engaged at the furnace at which Sofield was *not* at work were the co-servants of Sofield, and that as he was injured through their negligence there could be no recovery. The judgment of the trial court was therefore reversed. (46 Atl. R., 711.)

A WARRANTY ON MACHINERY SOLD.

John R. Bonnell and two other individuals being interested together in an ice plant and ice business, entered into a contract of purchase of an ice machine from the York Manufacturing Company. The agreed price of the machine was $11,000, and in the contract there was a warranty to the effect that the machine would make from 4½ to 5 tons of ice by the use of one ton of coal. Upon the completion of the plant a test was to be made to demonstrate the capacity of the machine. The test was made and it was found that the machine did not satisfy the warranty, and the purchasers refused to accept it. The York Manufacturing Company then agreed that if the purchasers would make a cash payment on the machine and execute notes for the balance it would make the plant produce the quantity of ice referred to in the contract and in all ways comply with the warranty. This proposition was accepted, and the cash payment made and the notes executed.

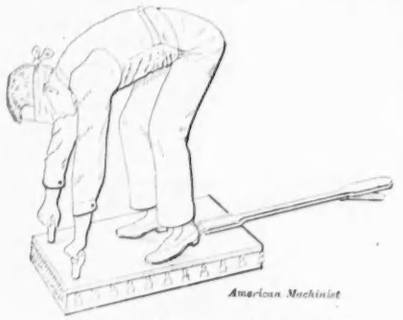
Shortly after this two of the purchasers sold a one-third interest in the contract and business to one Berryman, and thereupon a note was executed by all the purchasers and given to the vendor of the machine, in place of and in renewal of one of the former notes. The vendor of the machine sued on the note, and the defendants set up a breach of the warranty as a counter claim.

The case was tried in the Circuit Court of Fountain county, Indiana, and resulted in a judgment for the defendant. The plaintiff appealed to the Appellate Court of Indiana and the judgment of the lower court was affirmed. The Appellate Court held that Berryman, although not one of the original contractors, had an equal right with the other makers of the renewal note to the benefit of the warranty, and that the contention of the plaintiff that the original warranty ceased to exist when the plant was accepted and payments arranged was not tenable. The court further held that by the oral agreement no new warranty was substituted for that

contained in the original contract, and that it was simply a reaffirmance of the original warranty.

A Recent "Useful" United States Patent.

The accompanying cut is from a recent United States patent for a "useful" invention. It embodies also one of the latest applications of electricity. It is stated to



A "USEFUL" PATENTED DEVICE.

be for "initiations." The pull upon the handles in front puts the paddle in motion in the rear, and an electric current, which is provided for, supplies the operator with the impulse which might otherwise be lacking. Is it for this sort of thing that the Patent Office exists? Is this even "harmless," which is the official synonym for "useful?"

Examinations for First-Class Marine Draftsman—Engineer and Electrician.

The United States Civil Service Commission announces that on September 18, 19, 20, 1900, an examination will be held in any city of the United States where it has a local board of examiners for the position of first-class marine draftsman, with special experience in marine work. From the eligibles resulting certification will be made to that position in the construction and repair department, Newport News, Va., at a salary of $5 per day. Persons who desire to compete should at once apply to the United States Civil Service Commission, Washington, D. C., for application forms 304 and 375, which should be properly executed and promptly forwarded to the commission.

The United States Civil Service Commission also announces that it is desired to establish an eligible register for the position of engineer and electrician. An applicant must show that he is both a competent engineer and electrician. No educational test will be given, but applicants will be graded upon their age, character as a workman, experience and physical qualifications as shown by the information furnished in connection with their formal applications. It will not be necessary for applicants to appear at any place for examination. The age limit is twenty years or over. The eligibles resulting from this examination will be considered for certification for a position in any part of the service in their localities which requires the qualifications demonstrated by this examination. The only vacancy of which the commission has knowledge at present is in the position of engineer, qualified as an electrician, at the Warm Springs Indian School, Oregon, at a salary of $720 per annum. In this case preference will be given to eligibles in that district. Persons who desire to compete should at once apply to the United States Civil Service Commission, Washington, D. C., for application form 1093, which should be properly executed and filed with the commission prior to the hour of closing business on September 15, 1900.

An Automobile Accident.

One of the most serious automobile accidents yet reported occurred at Pittsburgh, Pa., on August 18. The vehicle was owned by a lawyer of Pittsburgh, and he had as a companion an official of the Carnegie Company. The vehicle was steam propelled, the steam being generated by the combustion of gasoline. First, the driver lost control of the motor or steering apparatus and the vehicle upset. This was followed immediately by the explosion of the gasoline tank. The machine was thrown up in the air and the driver was thrown out, striking on his head. The other rider was entangled in the machine and fell back with it, and was severely burned while unable to move. The gasoline tank is said to have carried a pressure of 30 pounds and the steam boiler 200 pounds. The carriage was so wrecked that it cannot be repaired.

Commercial Review.

NEW YORK, Saturday, Sept. 1.

There is nothing noteworthy to report by way of difference in conditions between last week and the present one. The recently reported closing of a large rod and nail mill at Anderson, Ind., may be taken either as an indication of conditions not altogether satisfactory in the market, or as a move by the combination designed to be in some way to its own advantage.

The general volume of business in the iron trade compares favorably with what has been doing for some time past, and especially so with corresponding periods of former years. Although we hear occasionally of dull business in machinery lines, we think it can be said that business generally is good, and the feeling is that it will continue so.

Reports reach us that American exhibitors of machinery at Paris are now doing better in sales than at first they seemed likely to do, and a number of them report themselves as well satisfied with the exhibition upon the basis of immediate orders, although, of course, there is no way of telling in most cases what proportion of these orders would have been booked this year through the regular distributive agencies if there had been no exhibition. On account of Monday being a holiday, we go to press one day earlier than usual, and up to the time of closing our forms have a report from Chicago only, which is as follows:

CHICAGO MACHINERY MARKET.

Many transactions involving the purchase of machine tools during August were delayed by the absence from works of the principals interested. Especially has this been true of negotiations in Chicago and vicinity. Extreme hot weather induced a general departure of individuals whose presence was needed for the conclusion of these transactions. The prospective buyers are now coming back, and within the past few days there has been a noticeable improvement in the number and volume of sales made. But the future is even more promising. Anticipations, based upon present inquiries, are that the fall trade will be excellent. Very little is heard about politics in business circles. It is being ignored to a degree that is quite uncommon in presidential years.

An influx at Chicago last week of small manufacturers throughout the West, due to the cheap rates made for the G. A. R. encampment, gave to the store trade a liveliness to which it had long been a stranger. These visits did not invariably lead to purchases, but many second-hand tools and a large number of the smaller machines were bought, and half-promises of orders in the near future were even more numerous. These visitors, as a rule, spoke most favorably of the business conditions prevailing in their respective localities, and all of them looked to the time when they would need a better equipment of shop.

About the only drawback to trade is the expressed opinion on the part of some buyers that prices of tools will be cheaper some months later, and not gaining the concessions which they had hoped for they are in some instances delaying their purchases. It is pointed out by some sellers that a little figuring will demonstrate the false economy of this delay, for the expected saving is often more than offset by the decreased cost of production which the use of the machine would bring to the shop using it in the meantime. There is some irregularity in the price of machine tools, but the generality of quotations is firm. Present buying is mainly in small lots, for a single tool or for several, to supplement existing equipment, but a number of complete shop outfits have been sold. August is going out with a much more satisfactory trade than that with which the month began.

Among the recent orders of Hill, Clarke & Co. was the equipment of a new manual training school in territory west of the Missouri River. The order amounted to about $8,000.

The capacity of the Pearson Machinery Company has been doubled within the past few weeks. The company will continue the manufacture of its old line of tools and add various other products.

Some Applications of the Vertical Type Milling Machine.

The accompanying half-tones illustrate some recent jobs being done on the Becker-Brainard vertical milling machine at the works of its makers. Except for the last illustration, which is a tool job, the work being done by the machine is the reproduction of itself—the lathe and planer being excluded from such work.

Fig. 1 shows a milling operation which is of a class for which the milling machine is too little appreciated, namely, circular milling, in which the machine competes with the lathe instead of the planer. The table of the circular milling attachment will be seen in position—this table being power driven. Of course, the economy of the milling machine on this class of work is at its maximum when, as in this case, the machined surface comprises an arc of a circle only, but when the profile of the cut is somewhat complex, necessitating frequent changes of lathe tools, this method of production will compare favorably with the lathe, even when the entire circle is to be machined. In the case shown we are informed that the time consumed on the milling machine is not over one-tenth of that formerly required by the lathe.

Fig. 2 shows a 12-inch inserted tooth face cutter roughing a plain surface, and is introduced partly to call attention again to a piece of correct practice in such cutters, which we have referred to before this, but which will bear repetition, as it gains recognition very slowly. We refer to the inclination backwards of the blades of the cutter, thus giving them a top rake and enabling them to cut the metal instead of pushing it off, as is too common. The blades will also be seen to be inclined outwardly as well as backwardly, in order to compensate for their own wear as they are pushed forward at each grinding. The cheap, and at the same time effective, method of holding the blades by a driven-in taper pin will also be noticed. Most tool makers who use this method consider it necessary to put a pin in each space between the teeth, but in this case a pin is used in each alternate space only.

Fig. 3 shows a job in progress on a comparatively small machine, which, if done on a planer, would require a large one. The saddles measure 63 inches over all, and a planer to do the work would have to pass that sized piece between the housings. With the milling machine, moreover, the piece is finished on the sides also, and at one setting.

Fig. 4 shows a tool making job, the work being the slotting of a cutter head similar to the one shown in Fig. 2. The dividing head shown is a special one designed especially for this class of work, its chief peculiarity being that it has a double angle adjustment, for giving both the backward and outward angles to the blades described in connection with Fig. 2. The cutter head blank will be seen to be dropped to give the backward inclination to the teeth, and then to be swung away from the milling machine column to give the outward inclination, the axis of the second movement being so inclined by the first as to make the final adjustment correct for the angles desired.

The Exclusive Agent—Imperfections of American Engines—German Shops.

BY W. H. BOOTH.

The question of exclusive agencies is one that has been of great trouble in this country, as well as having now turned up again in respect of American trade in Europe. I venture to say, for the information of all concerned, that no good and continuous business will be founded by any firms who are not prepared to grant exclusive agencies and to act honorably by their agents. I have seen manufacturing firms who had agents in London. The first year the agent would do perhaps £2,000, and would sink a lot of time and his own money in doing it. Next year he would do £5,000, and just live, and the third year he would do £10,000 or £15,000 and begin to make a good thing for himself. Then the unprincipled principal comes along and contrives to pick a quarrel with the agent, and being the stronger man gets rid of him, and perhaps goes scot free because of the agent's poverty or of some legal loophole in the agreement. The principal's idea is, that now he is doing £10,000 or more he can dispense with the agent and put in some young fellow at a salary; but I doubt if he gets any real benefit by his roguery. Agents of standing will not undertake business unless assured of permanency, because of the large initial expenses in building up a trade, and unless they have an exlcusive right to a certain territory they may do a lot of work, only to have the work taken out of their hands by some other agent who has simply come in at the last minute. A man once wrote: "I once had a partner with money, and he was very pleased for me to be a partner during the initial stages of the business, but when our auditors showed we were making 50 per cent. profit, he discovered that I was 'going to make too much money,' and he was so anxious to have the whole of the profit that he actually proposed I should now be paid manager. The result was, of course, that I found other work, and he sold our plant, which was useless to *him*, for a

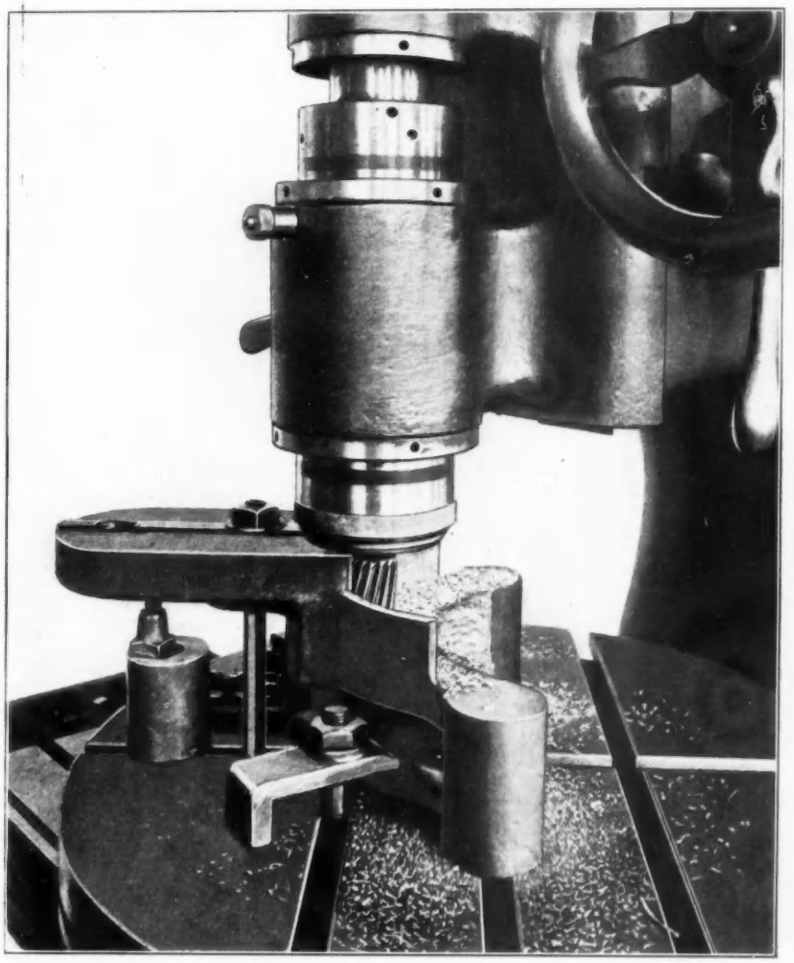


FIG. 1. CIRCULAR MILLING ON THE VERTICAL MILLING MACHINE.

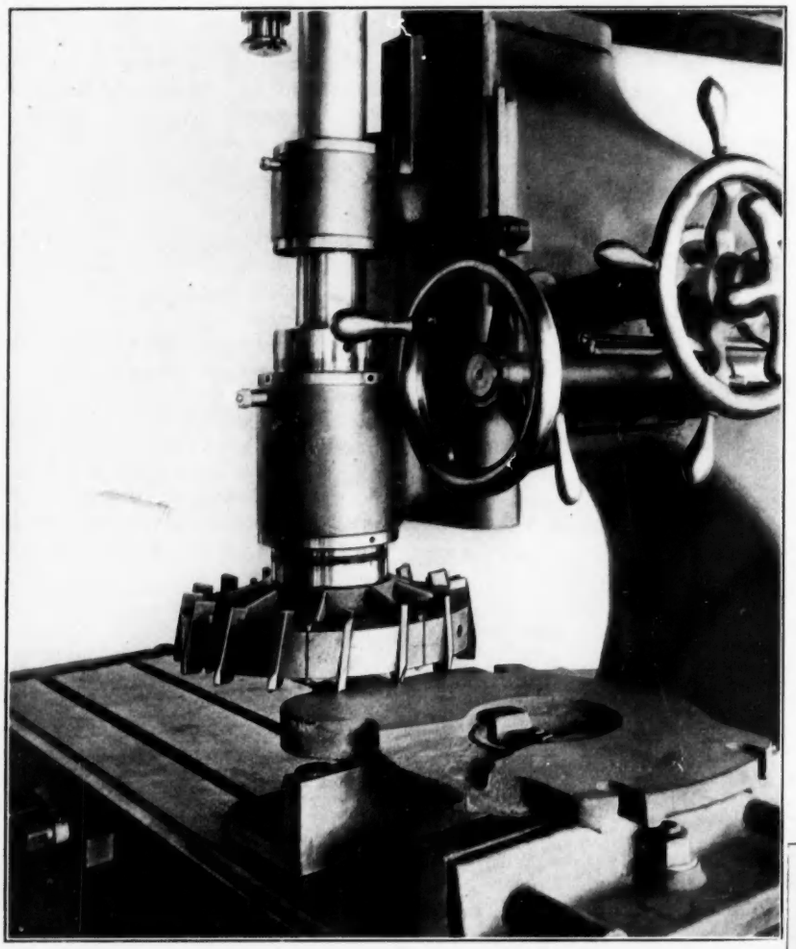


FIG. 2. SURFACE MILLING, SHOWING CORRECT MILLING CUTTER PRACTICE.

third of its cost, and out of greed he refused to earn his share of 50 per cent. because he could not have 45 per cent. all to himself." I have seen such greediness destroy more than one business; and though agents may be often at fault, I believe it is more often the principals who will not recognize the years of preliminary hard work by the agent, but grudge him anything more than a bare living when he begins to reap the reward of his accumulated labor. In other words, machine tools, engines and other vehicles are not sold in Europe by placing samples in a storeroom and expecting customers to come and buy, but they are sold by the personal efforts of the traveler, much of whose success is due as much to his personal qualities as to the qualities of what he has to sell.

The position of a seller is not altogether enviable. Only recently I had occasion to draw attention to a fault in some American machinery. I asked the agent why he did not get his people to remedy it, and he told me it was useless. If he made any suggestion he was told by his principals on your side that he was a "prejudiced Englishman" and didn't know what he wanted, which was not encouraging for pointing out a glaring fault in an otherwise most excellent machine. I have observed constant friction of this sort between makers and agents. It is usual to rail at English manufacturers because they have been too averse to altering things to suit customers at a distance; yet this is the very fault we have to find here with Americans. I will give an example. I wanted some steam-engine indicators for running long tests. Engineers familiar with indicator work will appreciate my desire to have a means of continually lubricating the instrument. Yet I could not get such a simple addition as a small oil inlet put to the indicator. No objection was made to paying extra for the addition, but the American maker replied that he never had made such an addition, and could not see how it could be done, though all he was asked to do was to put a small cock on the instrument, below the piston. Is not this worse than the traditional Englishman who is supposed to stick to a thing because it was approved by his grandfather. An agent on the ground usually knows what customers require, and when manufacturers make standard articles and object to customers demanding even the smallest addition or alteration, they should first be sure that their goods are perfect and beyond improvement. They may then reasonably object to make alterations. There may be good sound sense in

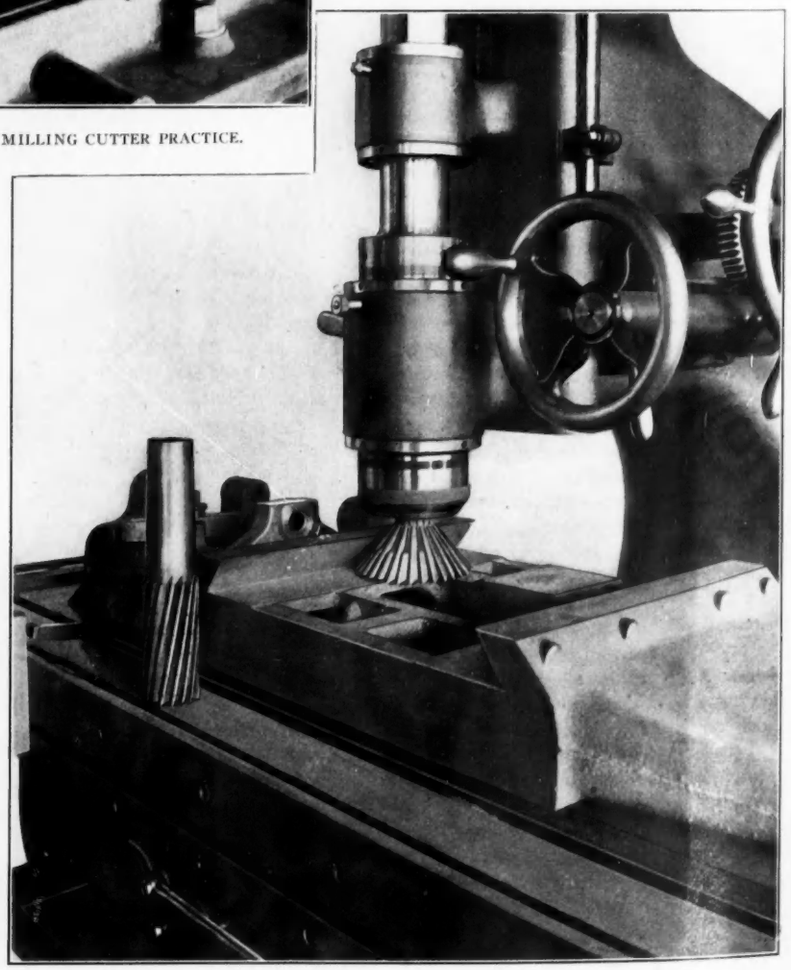


FIG. 3. DOING A LARGE JOB ON A SMALL MACHINE.

sticking to standard patterns and not altering until a large number of articles have been made alike; but this sort of thing may be carried too far. To revert to the indicator for example, one hardly ever sees the instrument arranged with a little detent to hold the cylinder at full revolution for paper changing. Yet this is an improvement brought out many years ago and now free of patent right, because I used it myself nearly twenty years ago. It was a most useful little device.

Then again, take the average American engine as sent over here, and note the gear supplied to drive the indicator. Nothing could be worse. There is a pillar carried off a slide bar bolt. A lever swings from a loose and badly fitted pin in the pillar head, and there is a quadrant on the lever that does not provide a pull short enough for any high-speed engine indicator, so that it is useless. Beyond this, on the back stroke the swinging lever is drawn hard back against the hood, and has to be cut out to clear this. Such is the gear supplied, not of a single maker only, thus proving that the gear had not been even put together, either in fact or on the drawing board. The last American engine I had to test was so badly fitted in this respect that we had to make a new gear throughout. It is a mistake also to fit engines for a certain indicator. All engines for this country should have a ¾-inch *inside* Whitworth thread, to which the top of any indicator may be screwed. As made, engines come over with all sorts of threads, and reducing nipples have to be made, and as the threads are not standard, they have to be cut on a lathe instead of being more easily and quickly screwed by taps or dies. A great defect noticed is the want of uniformity in small details. For example, two set screws for securing similar cotters at the two ends of a valve rod were not even alike in their heads. A separate spanner was required for each, and there was no reason of safety, or any other reason, why both these should not be identical. The same remark applies to various nuts about this same engine. This is not an exceptional case, nor is it drawn from any engine made by an unknown firm or firms. I do not say that similar faults are not to be found here on English made engines, but I name them because it is claimed that all American machinery is made interchangeable, and yet in scores of ways this is not the case with the productions of firms that stand high in their special lines. The system of interchangeable manufacture is one that should prevail, but it is an exceedingly bad system when only imperfectly carried out, and I know by painful experience that it often is very imperfectly carried out, even to the neglect in leading dimensions.

Reverting to the subject of agents, there are agents here in London, of American firms, who cannot produce a fully figured blueprint of what they have to sell. If written to for some leading dimension, they want time to refer to works, which means three weeks usually, and when finally stuff is delivered, it does not agree with the drawings.

Since writing the above, I have had the opportunity of seeing the Loewe Works, in Berlin. It seems to me that there the system of interchangeable manufacture is more fully carried out than anywhere else I have seen. The system of gaging with limit gages seems practically perfect, and

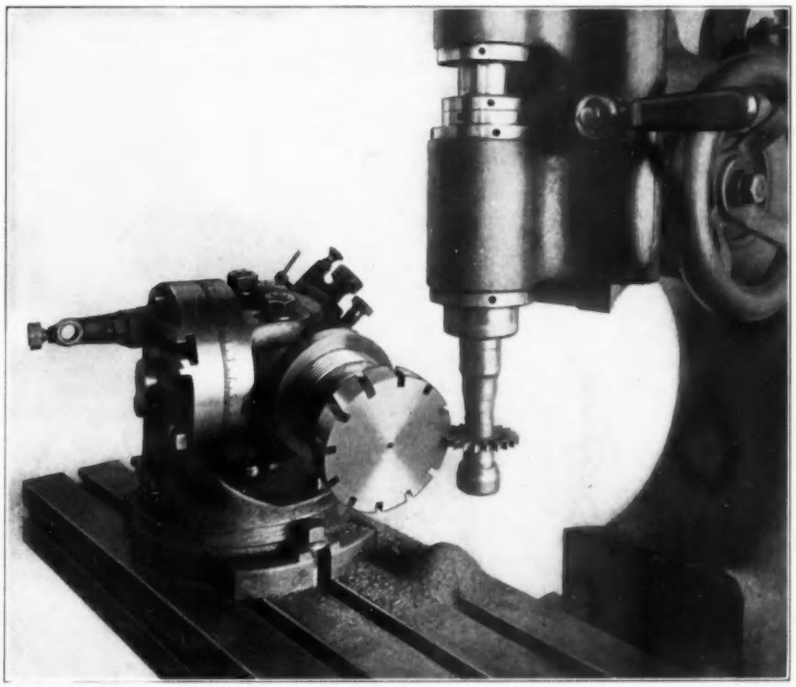


FIG. 4. A TOOL JOB WITH A NEW DIVIDING HEAD.

scientific methods are carried right through. Especially was this noticeable in the foundry, in passing through which we had given us some statistics of analysis, showing the method of calculating the cupola charges so as to secure a definite proportion of silicon, sulphur or carbon in the castings, as well as the analysis of pig iron as received. The testing department also is good, and, as I said, the best American tool shop is now in Germany, and the American or English visitor feels very much like the Queen of Sheba after going round the works of King Solomon. The fundamental idea has been to have everything of the best, and to secure this by starting in a plain field unhampered by any consideration of old buildings. So far as one could see, also, the only scrap-heap is the cupola, for the ground between the various buildings is laid out in grass and paved road, with the C. W. Hunt Company's excellent little railways to connect all lifts, and extending to all departments on all floors, so that one man can convey a load of 1 ton to any part of the works.

The men are paid for ten hours per day, and of that ten hours they are given fifteen minutes as the firm's contribution to cleanliness. Every department is practically an independent works, and there is no time registration at the main entrance, which would introduce loss and confusion owing to crowding, but every man registers on a time clock in his own department after changing clothes at the lavatory. There is a washroom in the basement of each department. Going-out time is registered at 11.45 A. M. and 6 P. M., and fifteen minutes is quite a considerable contribution to the time necessary to effect the four changes, especially when working in more than usually clean surroundings.

An example of the difference between a high-class shop and an ordinary one may be seen in the rack for bolts. The bolts used to attach work to a planer or other machine are very usually huddled into a rough box tucked away under a bench. Here they are all slung by their heads in a rack made from a series of H-bars laid parallel, with room between their flanges to take the bolt shank. The bars are carried in a simple frame, and each length of bolt is kept in its own channel, so that the machinist can pick what he wants at once. There is nothing in this little device that necessarily produces better work, but it certainly helps to produce equally good work at less price, saving the many hours usually spent in picking out the right bolt, and the further time wasted in screwing up such bolts when their threads are damaged by being thrown carelessly into the box. Another aid to economy is the rigid adherence to uniformity in the ceiling beams, which are so arranged that a countershaft can be put up or quickly shifted without drilling a hole. There is

thus a minimum of loss if a machine is to be put up or moved for better convenience of operation.

Owing to the smallness of power required by most of the tools, the system of power distribution is that by which shop shafting is run and the tools driven through countershafts. There are not separate motors to each tool, but separate motors to each room or group. The finest part of the whole works is the central electrical power-house, in which four large engines are awarded space sufficient, as ordinarily considered, for about double or treble the power. Power is distributed at 500 volts, and the power-house, more than perhaps any other department, illustrates a spirit of liberality which deserves success and will, we may hope, command it.

London.

Some Methods and Characteristics of a Berlin Tool Shop—I.

It will be remembered that last year* we gave a very full account of the new machine-tool building shops erected in Berlin by the firm of Ldw. Loewe & Co.—shops which are in many respects unique and which are fairly representative of the highest attainment of the age in the art of shop building. In the series of articles referred to above, we could not, for obvious reasons, go into details of shop practice, but were strictly confined to the shop buildings and the principal features of their equipment. Three years ago, when in Berlin, I had seen the drawings for these shops and the partially erected walls of some of the buildings, and, naturally, when I visited Berlin last May, one of the objects I had in view was to see these shops in their completed form and to see the work going through them. I have been asked by many different persons how I think the work done in these shops compares with the best work done in our own tool shops, and have frankly replied that I do not know. I do not pretend that I can go through a shop and tell just precisely what is the grade of work being done, nor how it compares with work done elsewhere, and am disposed to think that about the only way one can tell just what kind of work has been done on a machine tool—short of a dismemberment and test by gages—is to live with the tool for a while, so to speak; *i. e.*, use it and observe what sort of work it does under all conditions and what kind of marks are made on the sliding surfaces by wear.

One can very readily see, however, by going through a shop, under favorable conditions, whether or not that shop has been provided with the means for doing good work and what degree of good thinking has been done in devising and constructing the fixtures and appliances by which good work is facilitated and by which it can be produced at a cost that people can be induced to pay for it. Though it is not possible to describe and illustrate all the interesting and good things that are to be seen in the Loewe shops, I am able to present some of those I noticed, and when they are studied they will probably reveal as much as it is possible for anyone to know about the quality of the work done, unless one has the special facilities for forming a judgment which have been mentioned above.

First, it should be remarked that the human side of the business, or the social prob'ems attending the conduct of an industrial establishment, are evidently given considerable attention in these shops. The men are made to feel that the proprietors and the management fully recognize the fact that employees are not mere automatons; that they are in fact something more than mere assemblages of vitalized matter, useful for performing mechanical operations. Not only does an exceptional degree of cleanliness and neatness pervade the place, but the men are induced to take such an interest and pride in the cleanliness of it that the cost of keeping it so is reduced to the minimum. Furthermore, every encouragement is given to employees to be ambitious and to improve themselves in every possible way, and in very few shops that I have ever seen are there a better looking set of employees or men that seem to give evidence of more intelligent interest in the work and in the general prosperity and well-being of the establishment. The men who manage the establishment seem to fully believe in the importance of the part played by "the man behind the gun," and they devote considerable thought to the problem of attracting and holding the best men and giving full play to their best efforts. It is gratifying to be able to say that they have found this to be a good thing to do, from the strictly business standpoint, to say nothing of its superiority as a means of promoting good feeling and eliminating the unpleasant friction that in many establishments uses up more vital force of both managers and men than is required for the actual work, for the doing of which the shops are supposed to be built and carried on.

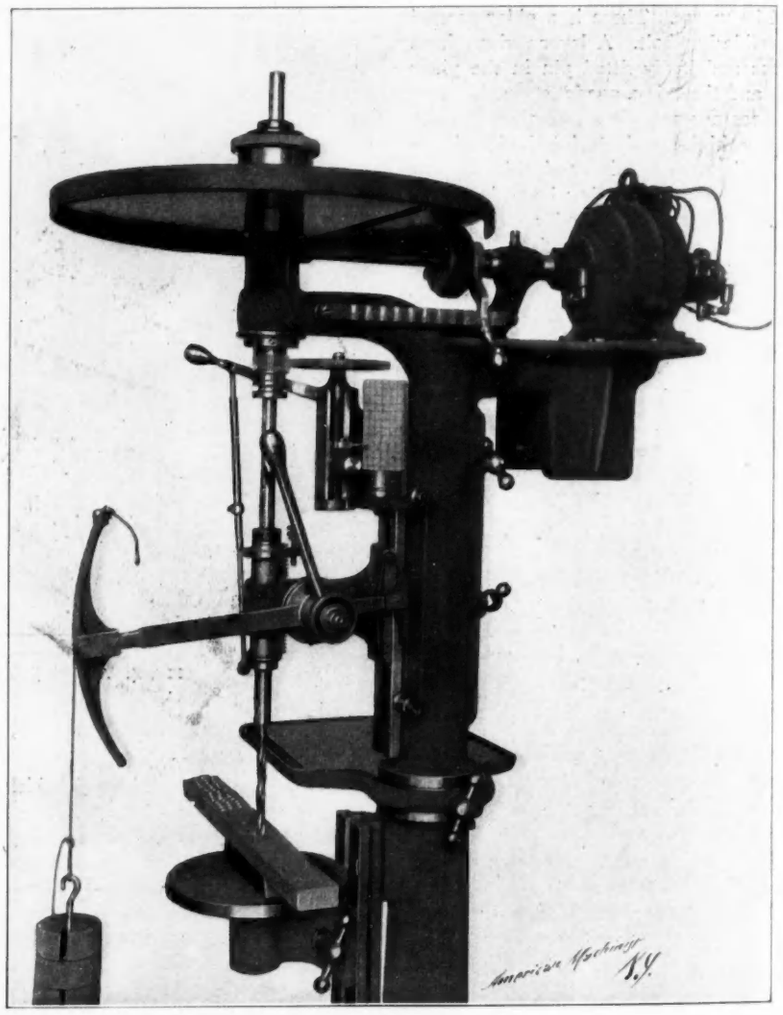


FIG. I. MACHINE FOR TESTING AND MAKING AUTOGRAPHIC RECORDS OF THE HARDNESS OF CAST IRON. SHOPS OF LDW. LOEWE & CO., BERLIN.

LOEWENBRAU.

As an instance of the spirit that pervades the place, and also as showing that

*At Pages 907-911, 931-936, 955-959 and 981-988.

some of the shop problems encountered in Germany differ considerably from those we find here, the treatment of the beer question is interesting. The German workman is in the habit of drinking considerable beer. He brings it into the shop, or it is brought in to him, to be absorbed at intervals, both with his luncheon and while at work. The management of this establishment concluded from careful and, I believe unprejudiced investigation, that this beer was not doing the men any good, but rather harm, both as workmen and otherwise. Having come to this conclusion, they did not, however, adopt the imperialistic attitude and simply prohibit the drinking of beer on the premises, but they attacked the evil by a flank movement which aroused no opposition, caused no talk about interference with personal rights or liberties, and which is proving to be entirely successful. In an otherwise unused portion of a basement of one of the buildings they set up an elegant tea-brewing plant; they bought the best brand of tea obtainable, and they sell this tea in stoppered bottles, from the tool-room windows, at cost and at a price which makes is considerably cheaper than the beer. A vast majority of the men have therefore voluntarily changed from beer to cold tea, which seems to indicate that their former absorption of beer might have been due more to a prejudice against plain water than devotion to Gambrinus. The bottles hold ½ liter (about 1 pint), and about 1,000 of these bottles are sold per day to the men at 4 phenigs (practically 1 cent) per bottle. There is brand of beer popular in Berlin (and not unknown in New York), that is called "Loewenbräu," which, translated into English, would be Lion Brew, and as the English for Mr. Loewe's name is Lion, the men call this tea "Loewenbräu," and that is the name it goes by altogether. The men probably mean this for a compliment to the tea, and by personal trial I can say that it is worthy of being complimented, although I am not very partial to tea.

AN IMPROVED MACHINE FOR TESTING HARDNESS.

Naturally, about the first thing to be thought of in connection with the construction of a machine is the material of which it is to be made, and as an assistance to the intelligent selection of the materials used in this establishment there is, as no doubt will be remembered, a testing laboratory, which is very completely equipped with the chemical and other apparatus required for analyzing and testing materials. Here the thing that interested me most, and that is perhaps the most novel feature of the equipment, is a development of the late Charles A. Bauer's idea of a machine for testing the hardness of metals—principally cast iron. In our issue of April 1, 1897, we gave an illustrated description of this method and of the machine used in carrying it on by Mr. Bauer in the factory of The Warder, Bushnell & Glessner Company at Springfield, Ohio. It was simply some inexpensive modifications of a simple driller, so that a

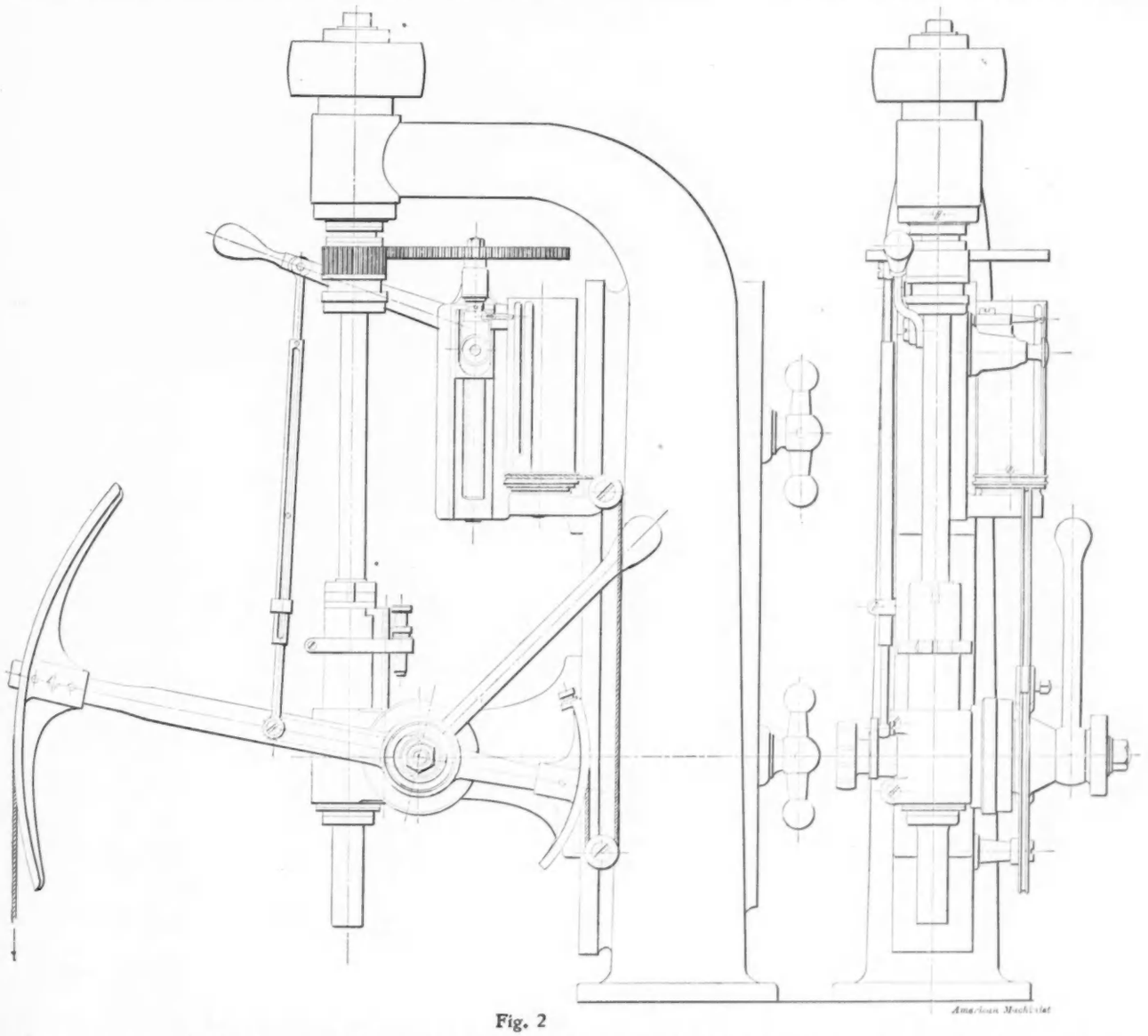


Fig. 2

MACHINE FOR TESTING AND MAKING AUTOGRAPHIC RECORD OF THE HARDNESS OF TEST PIECES. SHOPS OF LDW. LOEWE & CO., BERLIN.

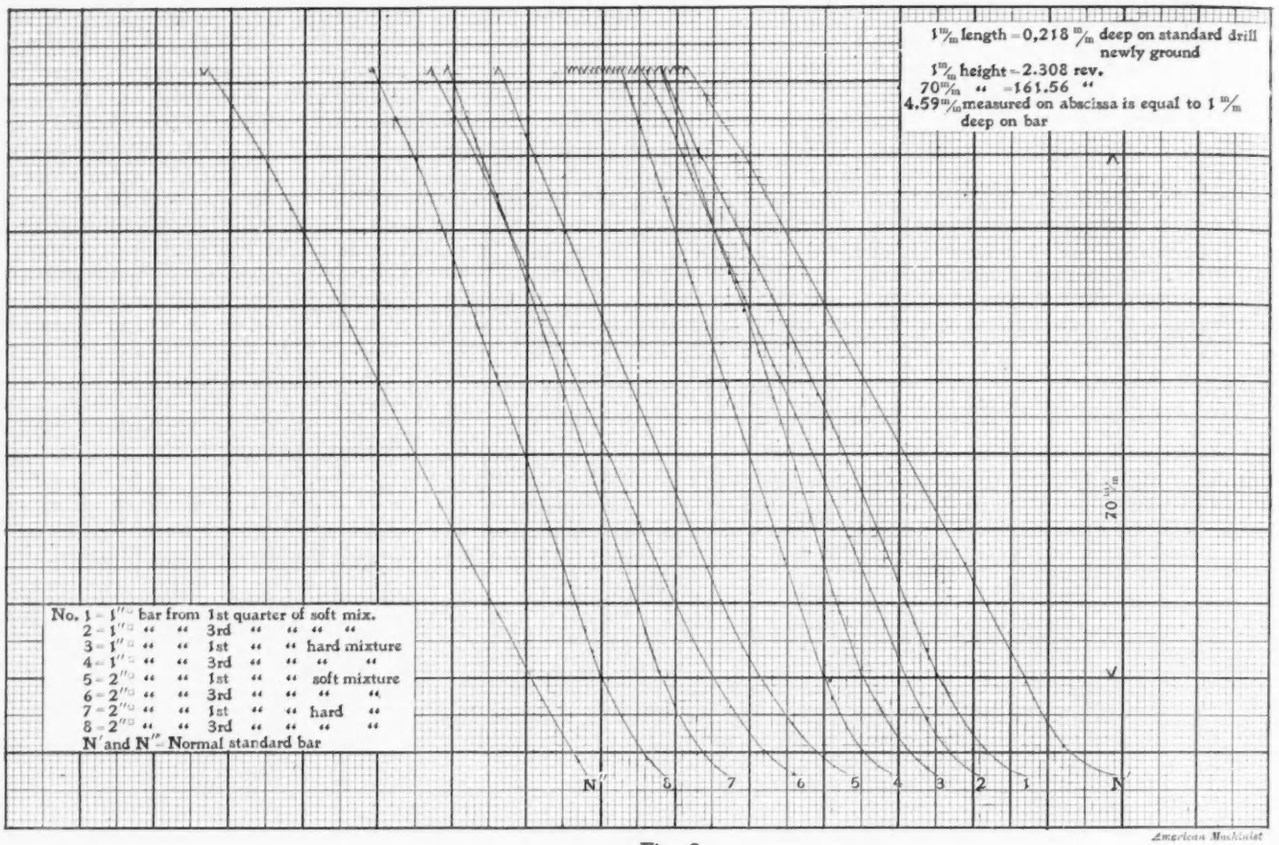

1 m/m length = 0,218 m/m deep on standard drill newly ground
1 m/m height = 2.308 rev.
70 m/m " = 161.56 "
4.59 m/m measured on abscissa is equal to 1 m/m deep on bar
No. 1 = 1/10 bar from 1st quarter of soft mix.
2 = 1/10 " " 3rd " " " "
3 = 1/10 " " 1st " " hard mixture
4 = 1/10 " " 3rd " " " "
5 = 2/10 " " 1st " " soft mixture
6 = 2/10 " " 3rd " " " "
7 = 2/10 " " 1st " " hard "
8 = 2/10 " " 3rd " " " "
N' and N" = Normal standard bar
N" 8 7 6 5 4 3 2 1 N'
20 m/m
American Machinist

Fig. 3

AUTOGRAPHIC RECORD OF THE COMPARATIVE HARDNESS OF CAST-IRON TEST BARS. DIAGRAM MADE BY MACHINE SHOWN IN FIGS. 1 AND 2.

standard drill could be put through a standard test-bar, with a standard weight to do the feeding and a revolution counter to indicate how many revolutions of the standard drill were required to drill through the bar. Mr. F. D. Carney, an American, who is in charge of the testing department at the Loewe establishment, has, with the assistance of Mr. C. L. Libby, elaborated this idea so that his drill press makes a diagram, from which not only the relative degree of hardness can be seen at a glance, but also whether the bar is harder in any one portion of its thickness than at another. These diagrams may be said to be a test-bar's own record of what its hardness is as compared with what is taken as a standard or satisfactory bar.

The arrangement of the machine will be understood from the photograph Fig. 1 and the drawing Fig. 2, while the nature of the diagrams made by it will be seen from Fig. 3. The driller is driven by an electric motor with friction device for getting any required speed. To the pinion feed shaft is attached a double-ended lever, the outer arm of which carries a sector to which the weight that does the feeding is attached by a cord. The other arm of the lever, which is shorter, carries a smaller sector, to which is attached a cord that is passed around suitable guiding pulleys that lead it to the drum of an indicator, which drum is thus made to rotate as the spindle descends in drilling. Alongside of the drum is a small slide, to which is fitted the pencil-carrying carriage, and this carriage is moved by a screw which is driven in the manner indicated by the rotation of the spindle of the machine. Thus it is seen that if the spindle were to move vertically without rotation, a horizontal line would be drawn upon the paper placed upon the drum; while if the spindle were, on the other hand, to be rotated without moving vertically, a vertical line would be drawn upon the paper, and it follows that the angle of inclination found in any line that is actually drawn will depend upon the relation existing between the vertical movement of the spindle and its rate of rotation; or, in other words, upon the number of turns the drill has to make to drill a given distance into the test-bar when it is fed by the standard weight attached to the sector. The upper lever controls a clutch, by which the traversing screw is stopped, either by hand or automatically, as may be determined by setting a collar on the telescopic sliding connection between the two levers. Upon the diagram, Fig. 3, Mr. Carney has caused several bars to record their hardness as compared with a standard or normal bar, and his explanatory notes are reproduced also upon the diagram. It will be noticed that all the bars represented by the lines 1, 2—8 are shown to be harder than the bars represented by the lines *N'*, *N"*, which are designated as "normal or standard bars," and I am at a loss to account for the fact that some of the bars which are thus shown to be harder than the normal are nevertheless designated as of a soft mixture. I infer, however, that the standard bar is taken as the softest iron that is desirable, or that is used, so that the variations from the lines representing it will be all in one direction for the irons tested from day to day.

It is perhaps hardly necessary to point out that this machine, thus arranged, affords a ready means of keeping close track of what the foundry is doing in the way of hard or soft castings and of promptly correcting any tendency to go beyond the desired bounds in either direction.

Although the revolution counter is dispensed with on this machine, it is, of course, necessary only to know the relation between the pitch of the traversing screw, the gears that drive it and the feed pinion and rack to be able to measure on the diagram the number of revolutions represented, and, as noted by Mr. Carney, a vertical hight of 1 m/m represents in this case 2.308 revolutions. Of course, it will be understood that the curves at the bottom of the lines represent the gradually increasing resistance as the drill enters the bar.

Mr. Carney is evidently very much interested in the work of his department, and is consequently a very interesting person to talk to about tests of materials. Among the other things he told me is that

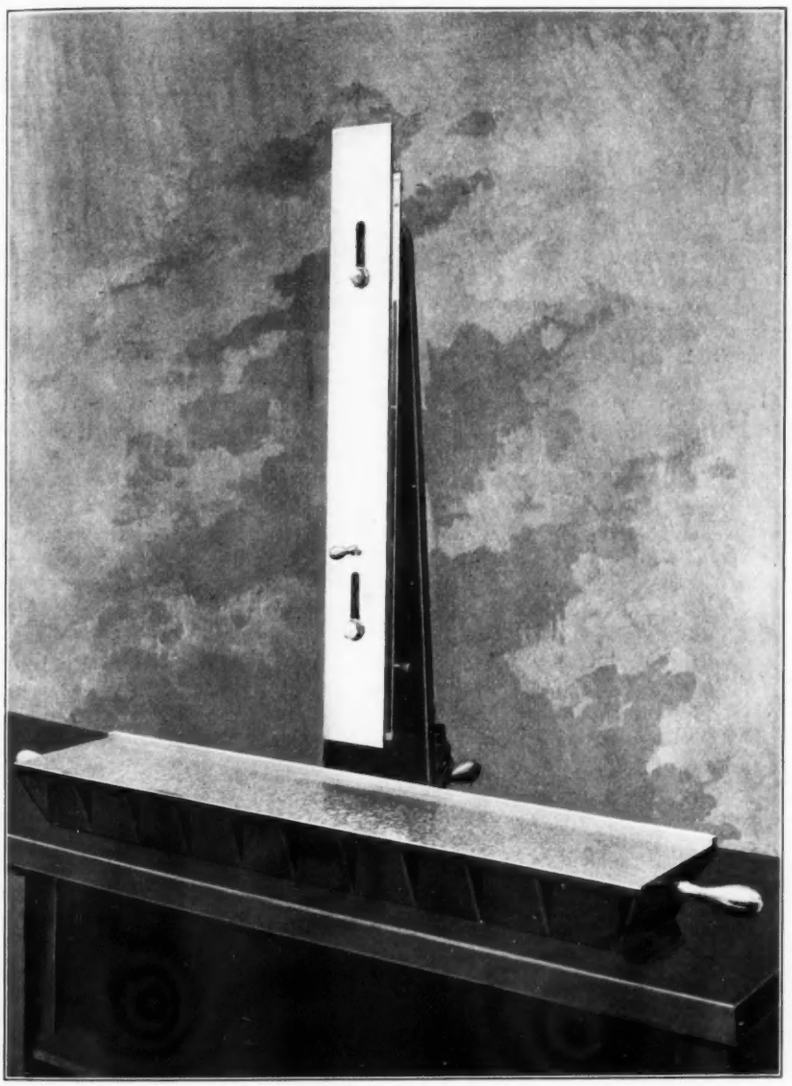


FIG. 4. DEVICE FOR TESTING SQUARES. SHOPS OF LDW. LOEWE & CO., BERLIN.

cupolas are interesting things when their product is tested each day, and he is coming to the conclusion that each cupola has its own individuality, so to speak, and that it must in a sense be calibrated before one can know what that particular cupola will do under given conditions. Of course, he is dealing, however, with variations of product that would either escape notice altogether in the absence of very refined means for detecting them, or would be attributed to unknowable and mysterious causes, or perhaps to d—— hard luck.

A DEVICE FOR TESTING SQUARES.

Another testing device which I noticed in the machine shop attracted my attention, and this is shown at Fig. 4. It will be recalled that in a former article we stated that the system of inspection in these shops is very rigid. Every piece is inspected as the different operations are completed upon it, and, of course, in doing this squares are used where necessary. There were constant complaints of the work not coming square from the milling machines and planers, and in very many cases where the inspectors declared a piece to be "out of square" and it was returned to the workman he was able to show that by the square he had used, and which had been supplied to him from the tool room, the piece was square. An investigation disclosed the fact that a piece might really be right by one square and a little off by another, and the trouble was thus traced to the squares themselves, although these had all come from the same establishment and were believed, and for that matter are still believed, to be the best and most accurate squares that are to be purchased anywhere. So the device Figs. 4 and 5 was made to test squares and to enable them to be corrected when

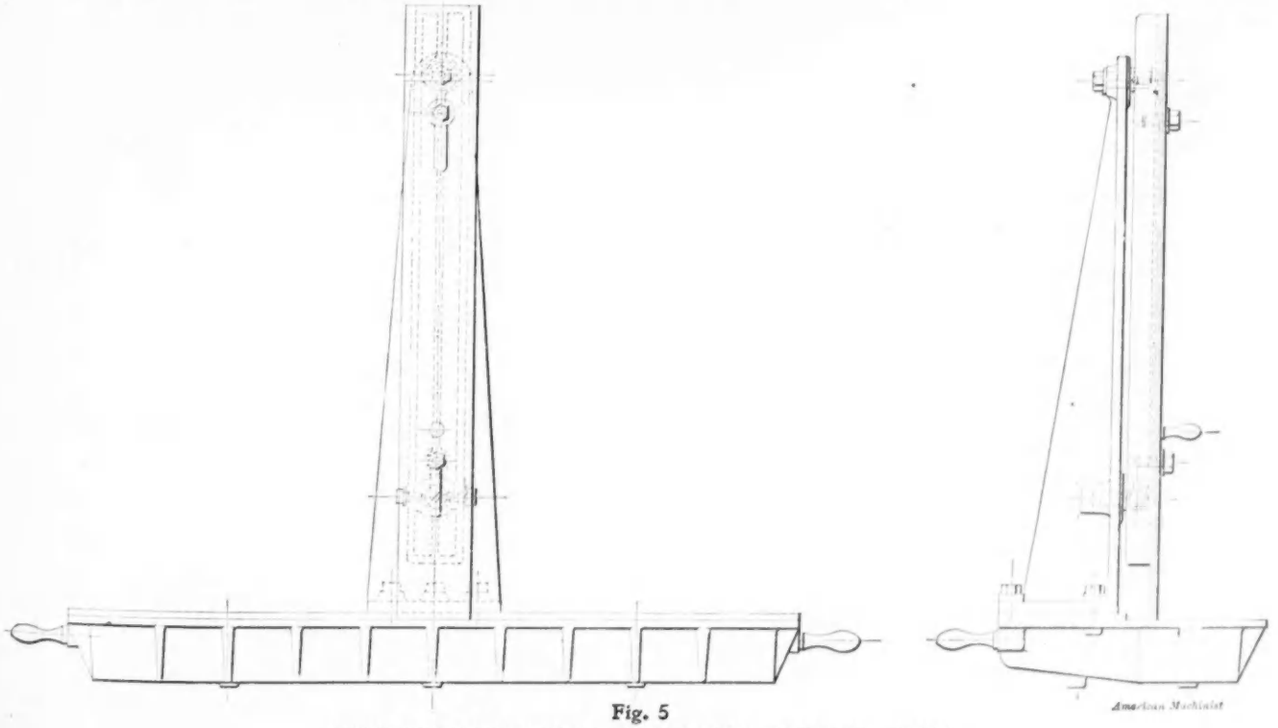


Fig. 5

DEVICE FOR TESTING SQUARES. SHOPS OF LDW. LOEWE & CO., BERLIN.

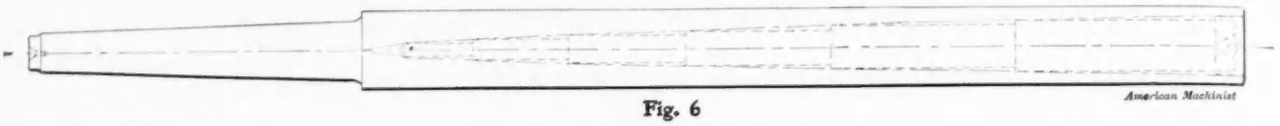


Fig. 6

A TEST BAR FOR HEADSTOCKS OF LATHES.

found slightly out. The surface plate which forms the base of the device was carefully fitted by scraping to an original plate, and at the back of this is attached a standard which supports a straight-edge that has its sides as nearly straight and parallel with each other as it was possible to make them. This is adjustable vertically through a small distance, so that the lower end of it can be brought close to the stock of a square placed upon the surface plate when testing the inside edge, or close to the surface plate when testing the outside of a square blade. At each edge of the straight-edge, but just back of it, a long, narrow mirror is placed. These mirrors swivel on pivots at top and bottom, so that the light which strikes them can be reflected to pass through the opening between a square blade and the edge of the straight-edge if there is any such opening, and when the straight-edge has been adjusted by means of knurled-head screws provided for that purpose, so that one edge of it exactly shuts out the light between itself and the square blade, the square is swung around to bring the same edge of its blade against the opposite edge of the straight-edge. This, of course, shows double the error that actually exists, and the square is then lapped until it will stand this test. It is now found that when an inspector declares a piece to be out of square it will be found to be out also by the square the workman used; in other words, the squares now agree with each other. It is, of course, a very refined test, and the device is beautifully made and finished. A drawing of the device is shown at Fig. 5, which, however, does not show the mirrors, one of which is seen in the photograph. Perhaps they were added to strengthen the light after the device was made. In adjusting the straight-edge to agree with a square being tested it swivels upon the pivot seen near the top of the standard in the drawing, and the adjusting screws are graduated to read to .001 m/m per foot of length, and this, of course, enables errors to be known in definite terms of magnitude.

TESTING-BAR FOR LATHE HEADSTOCKS.

Yet another testing device which interested me is used in connection with testing the alinement of lathe headstocks. A certain limit of error has been established for this, to which all lathes built in these shops must conform. In testing them a bar having a taper shank to fit the live spindle is placed in position within the spindle, and then an indicator, which is supported from the ways of the lathe is applied to this bar to see how nearly the spindle is parallel with the shears. The inspector was finding that the headstocks came persistently low in front, and in looking for the cause of this it was found that the unsupported end of the round steel bar, which is about 1 1-16 inches diameter and about 14 inches long, sagged at its outer end about .02 m/m, or slightly over .001 inch. To get over this difficulty, the bar, which had been made solid, was bored out, as shown at Fig. 6, using drills of constantly decreasing diameter, as shown by the dotted lines, and running each drill in to such a depth that its corner cut the line of a parabola. A center being placed in the outer end so that the bar could be finished by grinding, it was found that this bar, thus lightened to give it the maximum of rigidity in proportion to its weight, showed practically no sagging by the most refined tests which could be applied to it.

A DRILLING AND FACING JIG.

In manufacturing machine tools in large lots, as is the practice of this establishment, jigs are very much used, and, as is the case in our own best shops, every effort is made to so arrange the jigs and tools that the minimum of measuring or gaging will have to be done by the workman, and also so that there will be the least possible chance for him to go wrong with the work. At Fig. 7 a drawing of a typical jig, such as is used here, is shown and at Fig. 8 the same jig is seen in use. It is for boring and facing the piece shown at the side of the jig in the photograph, and by the dotted lines within the jig on the drawing, and the special feature of it is in the provision made for facing the work by so arranging the jig and the tools that the workman has only to face to a positive stop, and the work is sure to be just right. The frame of the jig is bored for the bushings, with holes large enough to admit of the facing-cutter passing through when the bushings are removed, which they are arranged for. The upper side of the hole for the bushing is faced with a hardened steel ring (*a*, Fig. 7). The distances *b*—*d* and *e*—*f* are made the same, and so when the adjustable collars on the shank of the counterbore are made the same distance from the edge of the facing cutter, and the facing continues until this collar comes into contact with the hardened ring, the facing is sure to be right, and there is no need for the operator to apply a gage, nor much chance for him to do the work otherwise than just right. It is the same with the distance *g* from the lower facing in Fig. 7 to the facing of the smaller bore; the tools are adjusted in the tool room to make the distance from collar to cutting edge just equal to the distance fixed by the jig, and the work goes ahead without much chance of error. The counterbores are not guided by the jig, as the boring tools are, but by the previously bored hole. Aprons for fifty 24-inch lathes, for instance, recently finished in this manner come well within the limits of variation desired, and of course the work is much more rapidly done than where the facing must be gaged in any way. F. J. M.

(To be concluded next week.)

The Metric System.

Some months ago the government addressed a circular letter to our representatives in Europe asking for information relating to the metric system in the various countries. It appears from the replies which have just been published that the change to the metric system in Austria was made in 1876, and met with many difficulties, as the new scale bore no resemblance to that which it superseded. The alteration was, however, facilitated by wise concessions, the transition period was over in four years, and the method now gives complete satisfaction in Austria and Hungary. The metric system is firmly established in Belgium, where it came into general use in 1855, while the question of introducing it in Denmark is under consideration, the majority of the commercial and professional classes being in favor of the reform. In France, where the law was brought into force in 1837, all authorities are agreed that the metric system has been commercially beneficial, and the principle has also been firmly established in Germany, where it was brought forward in 1868, and has been of advantage to the trade of the country. Too much prejudice against the system exists in Greece, and the government has therefore refrained from making it compulsory; but in Italy its use was made uniform by legislation in 1890. The obstacles encountered in enforcing the principle in the Netherlands have gradually been removed, and it is now in operation throughout the country.

In Portugal, where the method was introduced in 1852, little opposition was manifested, as about twelve years were occupied in carrying it into effect; and Spain adopted the system in 1869, Norway and Sweden in 1879, and Switzerland in 1877. Taken altogether, the metric system appears to have proved beneficial, and no desire exists for reverting to former methods.—"Mechanical World," Manchester.

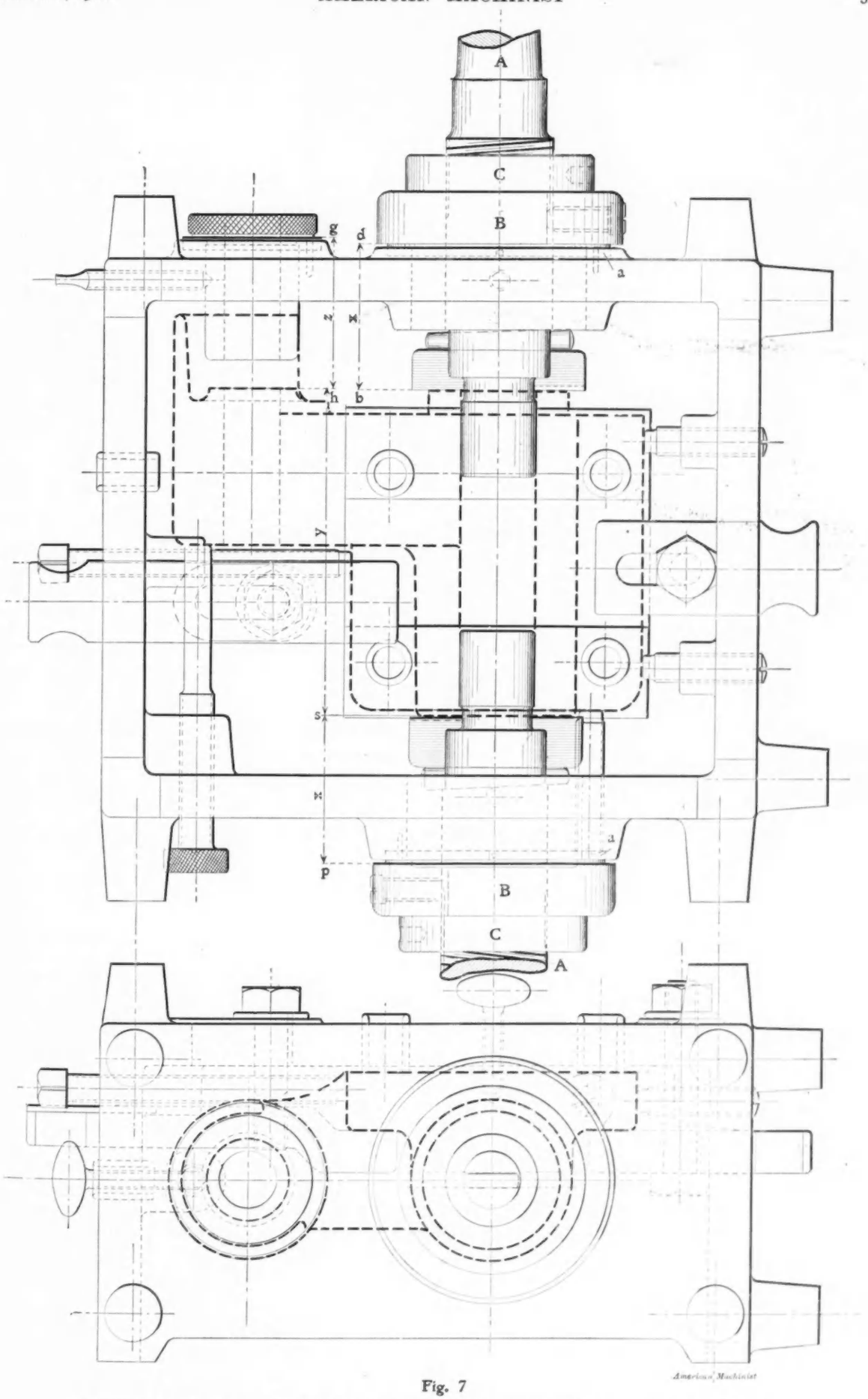


Fig. 7

DRILLING AND FACING JIG FOR PART OF A MACHINE TOOL. SHOPS OF LDW. LOEWE & CO., BERLIN.

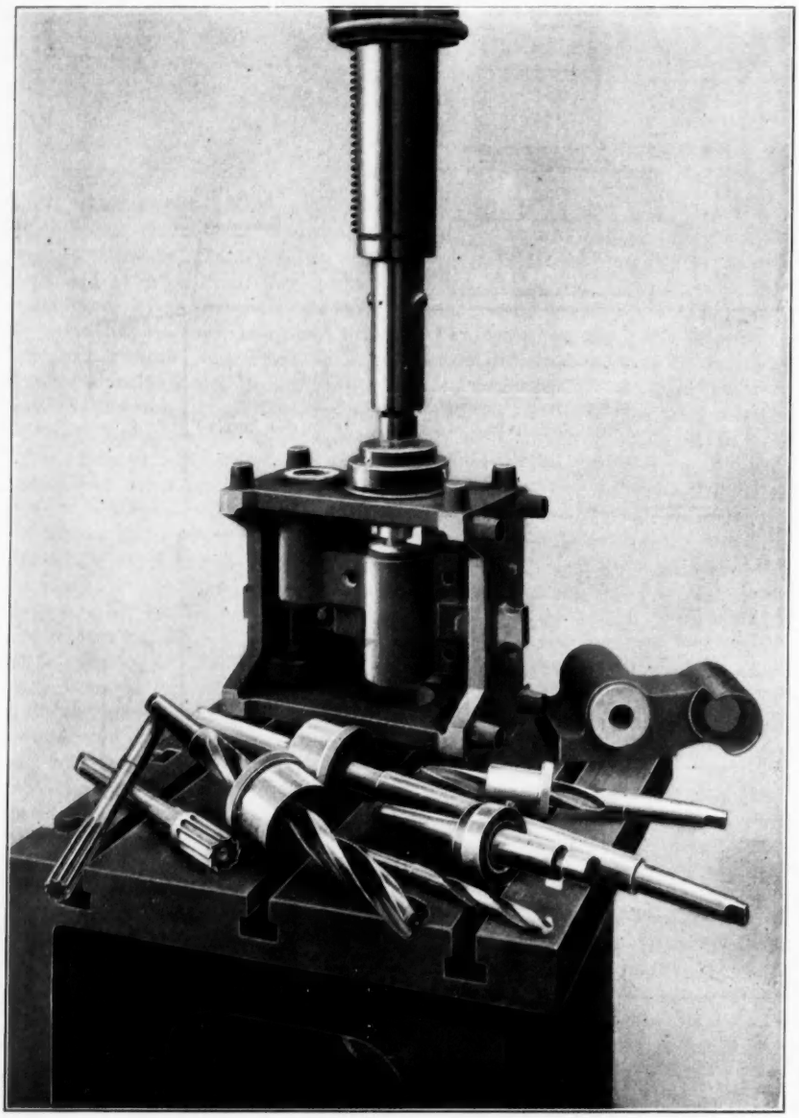


FIG. 8. DRILLING AND FACING JIG. SHOPS OF LDW. LOEWE & CO., BERLIN.

Steel Castings.*

It is fifty years since the first steel castings were made, but until quite recently the production was very limited, owing to the difficulty of obtaining the liquid metal in sufficient quantities for making very large castings. Attempts were made at the time of their first appearance to utilize the Bessemer converter and the open-hearth furnace, but not with good results. About 1885, M. Robert invented his converter with side blast, which, applied to the casting of steel, enabled the works to produce complicated castings of excellent quality, and in fact created a new industry, for the sphere of their utility has been extending ever since. Many difficulties have, however, had to be surmounted by the steel founders, and it is only in virtue of their perseverance and ingenuity that the new craft has become a success.

The fusing point of steel is very high, ranging from 1,450 to 1,500 degrees, and in working the metal higher temperatures still are employed. This high fusing point and the contraction which steel undergoes when it cools were the source of much vexation to the steel founder. This shrinkage amounts to from 15 to 18, or even 20, m/m per meter, according to the heat and composition. If the mold offers too great a resistance to this contraction, there is a risk of the casting cracking or becoming crooked. The third source of anxiety was the appearance of flaws, because it is necessary that a steel casting should be perfectly sound. The united efforts of the manufacturers of steel and of the founders have, however, overcome every difficulty. After many experiments it was discovered how to prepare a suitable refractory sand, capable of withstanding the intense heat of the molten metal. It is composed of quartz, sand, silica, brick pounded, and other refractory materials, and it is rendered plastic by the addition of clay. The great shrinkage that steel experiences on cooling has most severely taxed the resources of the founder—and he has only been able to remedy its consequences by a number of contrivances, such as the introduction of ribs to strengthen dangerous parts, the early removal of the core which opposes the contraction of the metal, the releasing the casting while it is still red hot, etc.

With the facility of obtaining a regular supply of metal, the steel founders proceeded to improve their plants; the old cranes were replaced by electrical or steam lifting machinery of a power of 30, 50 and 100 tons; cold saws, compressed-air machine tools, and electric welding for remedying slight superficial defects, were introduced; and lastly, as denoting the great extension of the industry, the molding machine was adopted in steel foundries. The converters with a lateral blast, supplying steel at a very high temperature —which can be stored without becoming too cold to run into the mold— enable the founder to turn out with the aid of the machine worked by two men 600 to 1,000 kilos. per day of complicated castings weighing from 5 to 20 kilos. each. Another great improvement effected is the subjecting the pieces during annealing to a sudden cooling or tempering in air, which improves the quality of the steel. The castings are heated to 1,000 degrees, and then suddenly exposed to air at from 1,000 to 600 degrees. Their power to resist shocks is thereby vastly increased, and they are more elastic and more tough. Improvements in the construction of the crucible furnace, and the higher temperature now obtainable, enable very delicate and malleable castings to be at the present time made with a metal containing a much lower percentage of carbon than was possible formerly. Sundry correctives to the steel, such as aluminum, nickel, etc., are now added universally. The ameliorations made in the open-hearth furnace during the last ten years have greatly assisted the founder. The temperature, equality and purity of the metal have been improved. Acid metal is no longer necessarily hard as formerly. Basic furnaces have now been brought to such perfection that with their product excellent castings can be made, which ten years ago was impossible. The judicious employment of aluminum is responsible for this improvement, so that basic steel is in many cases now preferred to acid steel. In both kinds of metals the hardening constituents—carbon, manganese and silicon—have been diminished. The following is the average composition of open-hearth foundry steel:

Carbon ..... 0.25 to 0.50 per cent.
Manganese ..... 1.00 to 0.50 "
Silicium ..... 0.20 to 0.45 "

The increased employment of cast steel has led to the construction of furnaces of a capacity of 50 tons which are as reliable as those of 20 tons, and they are specially devoted to the production of steel for castings, and only rarely are ingots run

*From a paper by M. A. Tissot, read at the Mining and Metallurgical Congress, Paris. Centigrade temperatures are used.

from them. The converter, with the lateral blast of M. Robert, or imitations of the same, have now come into general use and seem to satisfy all the remaining requirements of the steel founder. Owing to the peculiar arrangement of the tuyeres, the output can be varied from 800 to 2,000 kilos., or from 3,000 to 6,000 kilos. in the two types of apparatus in use. The heating of the same is easy and inexpensive. The metal is milder than that produced by the Martin furnace, even when not employing any other than ordinary. It possesses great power in resisting shocks and a degree of elasticity which attains 110 kilos. per square millimeter; it is, therefore, naturally well adapted for war material and marine purposes. Nickel steel, with varying proportions of the first-named metal, is now also largely manufactured for armor plates, artillery, etc.

The first special steels which were introduced, such as chrome and manganese steel, did not produce any greater difficulties to working than ordinary steel. The conditions in forging, tempering and annealing were much the same as in carbon steel. Later varieties, notably those with a large admixture of nickel, owing to their extraordinary properties, presented difficulties of a formidable nature. Certain steels at the temperature at which carbon steel can be forged became hard. In others the process of annealing seems to have an action the very reverse of that it has on ordinary steel, and so forth. It required innumerable experiments and much scientific research to arrive at suitable methods of working the new alloys. According to the theory of Messrs. Carie, steel should be tempered when it is in a feeble magnetic condition at a high temperature. The determination of the point of magnetic transformation would be sufficient therefore in any case to determine the temperature suitable for tempering. Before the new alloys—notably the nickel steel—could be introduced into practical industry many difficulties had to be overcome, owing to their extreme hardness, which the drills, the cutters of the planing machine, etc., could not attack. However, by annealing the metal and the use of specially made tools, and by working at a reduced speed, the trouble has been overcome. The metal adopted at the works of Imphy for machine tools is chrome tungsten steel, tempered.

Dies for Metal Bottle Stoppers.

BY JOSEPH V. WOODWORTH.

The article shown in Fig. 1 is used as a stopper for rubber water bottles, and the dies about to be described were for making the handle *A* and the top piece *B*, shown in Figs. 2 and 3, respectively. The stopper is composed of five pieces—*A*, the handle; *B*, the top or rim; *C*, the stopper proper; *D*, a rubber washer, and *F*, a rivet for holding the same. The dies used for the other parts than those shown in Figs. 2 and 3 were not of sufficient interest to be shown here.

First, we will take the handle, Fig. 2, which was made of round brass rod, ⅛ inch diameter, cut into 3⅛-inch lengths, the ends turned down in the monitor, leaving square shoulders. The bending and forming was done in one operation by the punch and die shown in Fig. 4. The holder *A* was a machine steel forging, turned and finished, with a hole straight through the shank to admit the stem *C* of the forming punch. It was also counterbored, as shown, for the spring *D*; it was then milled across at *E*. The forming punch *B* was of tool steel, first turned so that the stem *C* would be a nice easy fit in the hole in the holder, and threaded for the two stop-nuts shown at the top. It was then chucked in the miller and the former milled to template, and also milled flat on the side, so as to work smoothly in slot in the holder at *E*. The taper pieces *F F* were then turned and milled to the shape shown, and after the holes for them in the holder were drilled and reamed they were hardened and driven home. After the forming punch was smoothed and polished it also was hardened and

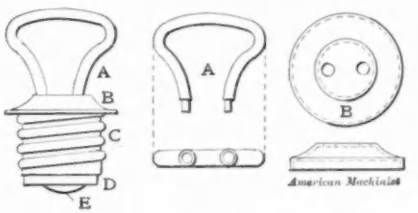


Fig. 1 Fig. 2 Fig. 3

THE BOTTLE STOPPER AND PARTS.

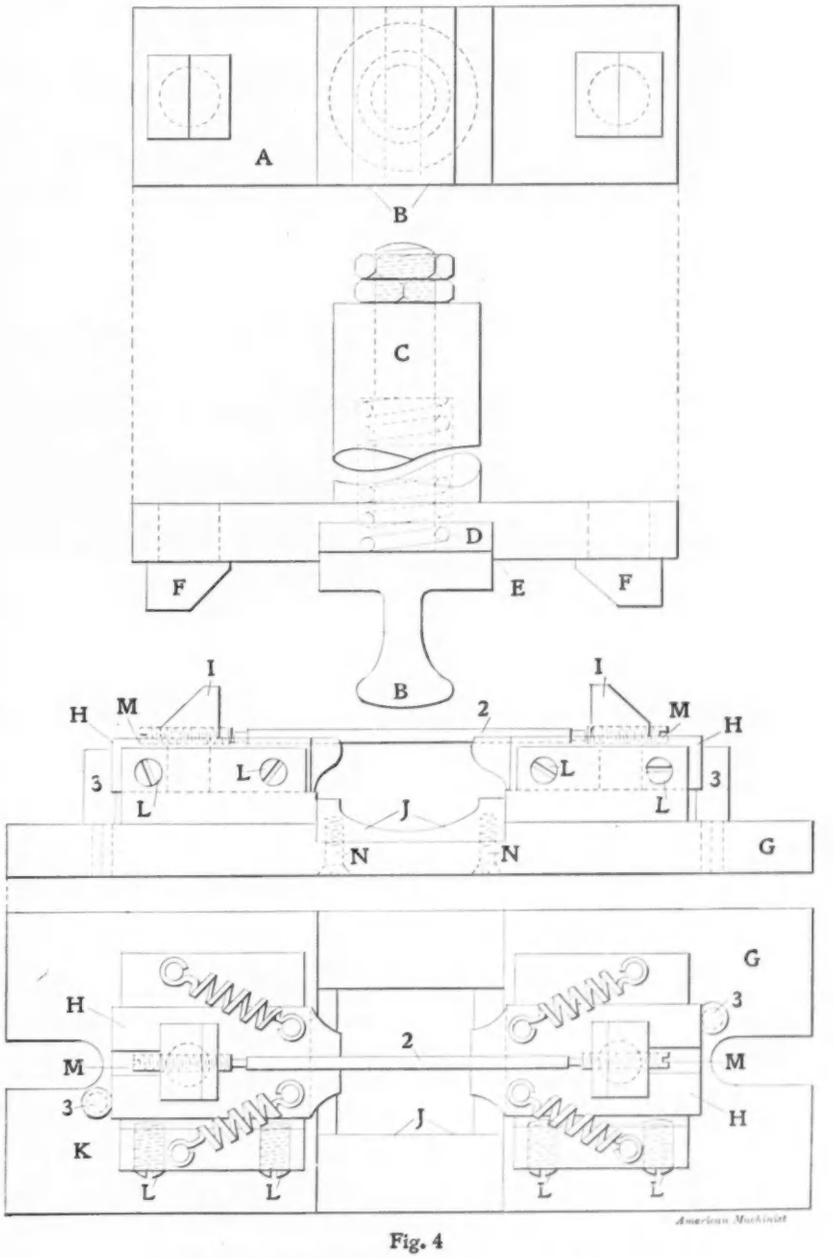


Fig. 4

BENDING AND FORMING PUNCH AND DIE FOR HANDLES.

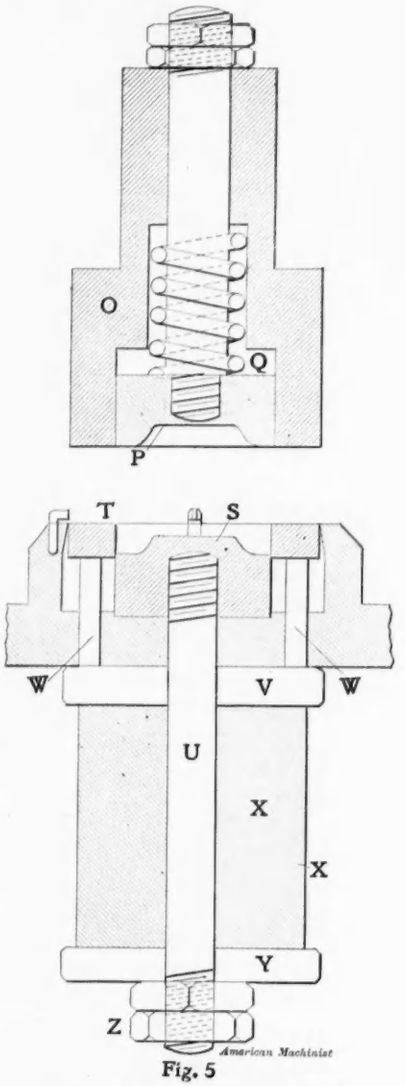


Fig. 5

PUNCHING AND FORMING THE CAP.

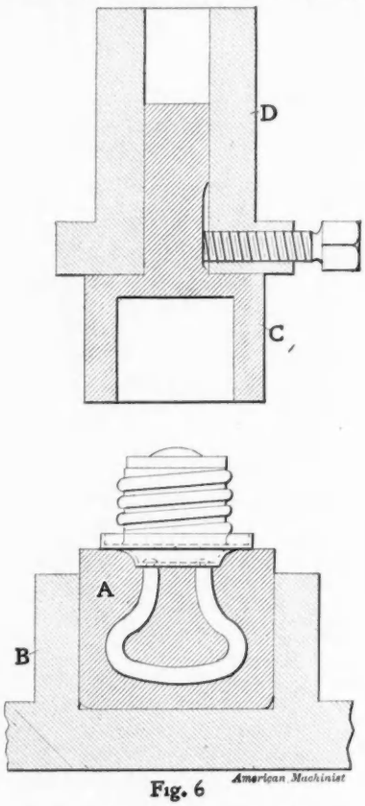


Fig. 6

WIRING DIE FOR BOTTLE STOPPERS.

drawn to a blue at the back; the spring *D*, of heavy spring wire, was made; the parts were assembled, and the punch was complete.

The die was then made. *G* is the bolster of cast iron, planed and milled to the shape shown, and dovetailed to admit the two forming slides *H H* and the gibs *K*. It was also milled straight across to admit the die *J*, which was made of tool steel, worked out, finished and hardened, inserted and held in position by the flat-head screws *N N*. The slides *H H* were of tool steel, worked out to the proper shape and fitted to be an easy sliding fit in the bolster. They were inserted and set in the proper position and the holes laid out for the taper pieces *I I*. They were then drilled and hardened and finished. The taper pieces *I I* were made of tool steel and holes drilled through them for the adjusting screws *M M*; they were then driven into the slides. After the slides were put in position and the gibs *K* adjusted by the screws *L L*, the stop-pins 3 3 were made and driven into the bolster and filed until the slides would come back just the proper distance, drawn by the spring on each, as shown.

I neglected to state that a half-round groove was let into the top of the slide as a form for the work to lie in. After all the parts were assembled, the die was set up in the press and the work, 2, placed in position as shown, the screws adjusted correctly, and all was ready for work. The punch *B* descends, striking the work in the center, and causes it to spring up and hug the sides, continuing down further until within ⅛ inch of the bottom, when the taper piece comes in contact, causing the forming slides *H H* to move inward, the punch continuing down until the work is entirely formed and finished. As the punch ascends, the springs carry the slides to the stop-pins 3 3, and after the work is removed the punch is ready for another. The spiral spring *D* in the punch is to allow the punch to remain stationary while the work is being formed by the slides.

The die shown in Fig. 5 is of the combination blanking and drawing type, and was used to produce the top shown in Fig. 3. The blanking punch *O* was a forging of machine steel, with a tool-steel face running up ½ inch. This was turned and finished all over, except the cutting edge, which was left until we had ground the die. The inside was bored out to the shape shown to admit the forming punch *P* and the knockout spring *Q*. The forming punch was of tool steel, finished to template and drilled and tapped to admit the stud, and after being hardened was assembled with the spring, in the way shown.

The die consisted of the blanking die *R*, of machine steel with a tool-steel ring welded on for the die proper. After being faced off on the back, it was swung in the lathe and finished out to the size of the blank, less enough for grinding; it was also recessed for the forming die *S* and the hole drilled for the spring barrel stud *U*, after the hole for the blank holder pins *W W*, of which there were six, and the holes for the gage and stripper pins were drilled. It was carefully hardened and drawn to a light straw color, then ground to the proper size; the blank holder *T*, a ring of tool steel, was made, hardened and the face ground. The forming die *S* was finished and worked out, and the hole for the stud let in; it was then hardened and not drawn. After the six pins were made and finished to exactly the same length, the stud *U* got out and the cast-iron washers *V* and *Y* made, the parts were all assembled, with the spring barrel *X*, in the way shown. After the blanking punch *O* was fitted to the die we were ready for work.

The stock used was .025 thick and of soft sheet brass. The punch descended and cut out the blank, when it was held tightly between the face of the punch and the blank holder while being drawn. The punch continuing down, the work was drawn and formed into the punch, and finished by a good sharp blow when the forming punch struck the shoulder inside the blanking punch. As the punch rose, the knockout spring *Q* caused the forming punch to spring out, thereby throwing out the finished piece shown in Fig. 3.

The two holes shown in the top of Fig. 3 were for the two ends of the handle *A*, Fig. 2, and were pierced in the ordinary way in the foot press. The handle, after being inserted, was put in the holder and riveted on the inside of the cap. The stopper was then ready for the final operation, which consisted of wiring the cap and enclosing the stopper proper *C* within. This was done in this manner: A piece of round tool steel, 1¾ inches diameter, was cut in half and milled flat, and after being sweated together, it was turned up to 1½ inches diameter, and the shape of the cap worked out in the face and polished smooth. After the halves were separated and the shape of the handle worked out on the inside, as shown at *A*, Fig. 6, they were hardened, and a holder was got out as shown at *B*; that is, so as to just fit the outside of the split die when the work was within it. The wiring punch is shown at *C* and the holder at *D*, and needs no description, except that the punch descending caused the rim of the work to collapse and be finished in the way shown at *B*, Fig. 1, thereby holding and riveting the lower part as though of one piece.

The dies used to produce the pieces *C*, *D* and *E*, respectively, although not of sufficient interest to show and explain in

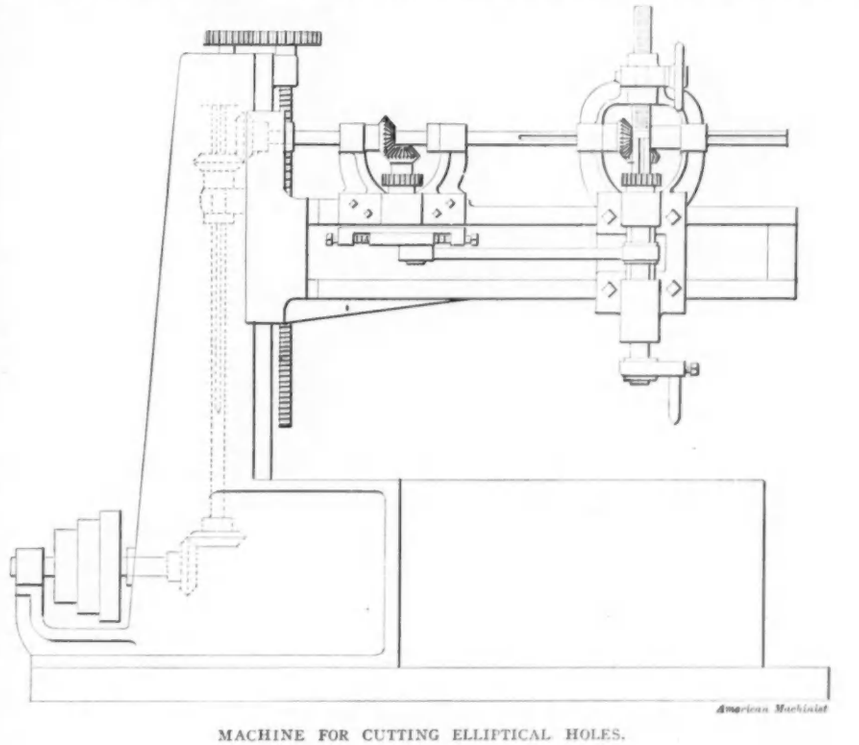
detail, will bear a slight description. The stopper proper *C* was made of sheet brass, the same thickness as the cap *B*, and was blanked and drawn in two operations; the first by the same kind of combination die used to produce the cap B, and the second by the ordinary reducing die. The hole in the bottom for the rivet E was pierced in the foot press, and then the thread was rolled on by the usual means in a thread-rolling machine. The rubber washers *D* were pierced and blanked in the usual gang die, care being taken to have all edges very keen. These also were made in the foot press. The rivet *E* was made in the monitor, and after being inserted through the washer *D* and the piece *C*, was upset in the foot press, leaving a half-round head on the inside as well as the outside. After the stopper was complete it was first highly polished and then nickel-plated, thereby leaving a piece of work that was a credit to the tools and the shop.

A Powerful Compound Locomotive.

The Baldwin Locomotive Works have recently turned out, for the Minneapolis, St. Paul & Sault Ste. Marie Railroad, a compound decapod locomotive guaranteed to haul 2,000 tons of train, exclusive of engine and tender, over a grade of 42 feet to the mile, exclusive of curve resistance, at 6 miles an hour. The total weight of the engine is 207,210 pounds, of which 184,360 pounds are on the ten driving wheels. The total length of engine and tender is 69 feet 7 inches. The cylinders are 17 and 28 inches by 32 inches stroke. The piston rods and crank pins are of Low Moor iron. The boiler is 68 inches diameter, of 11-16 and ¾-inch steel, carrying a working pressure of 215 pounds. The steel firebox is 131 inches long, 41 inches wide and 77⅜ inches deep in front and 76 inches at the rear. There are 344 2-inch tubes 15 feet 7 inches long. The grate area is 37.5 square feet, the heating surface of firebox 233.9 square feet, and of tubes 2,791.8 square feet.

A Machine for Cutting Elliptical Holes.

The cut shows the essential features of a machine for cutting elliptical holes in boiler plates, tank plates and similar work. It is normally a drill or a boring machine, and will drill or bore round holes in the usual way when elliptical work is not required. As elliptical holes, such as hand-holes or manholes, are generally of considerable size, a cutter is employed which cuts a groove in the plate and lets the center piece drop out when the thickness of the plate is cut through. The cutter is adjusted at such a distance from the center of the spindle that the outer cutting edge of it cuts a circle whose diameter is equal to the smaller diameter of the required ellipse. The saddle which carries the cutter spindle is arranged to slide laterally upon the arm of the machine. A second spindle upon a fixed saddle at the left carries on its lower end an adjustable crank, with a connecting rod which attaches at the other end to the boring spindle. This crank spindle always rotates at the same speed as the cutter spindle, and the crank is parallel with the cutter arm. The total throw of the crank is adjusted to be equal to the difference between the larger and the smaller diameters of the ellipse. Then when the machine is in motion the crank moves the cutter spindle laterally in each direction as the cutter revolves, and the elliptical hole is cut as required. The device, which has been recently patented, is the invention of John S. Worth, Coatesville, Pa.

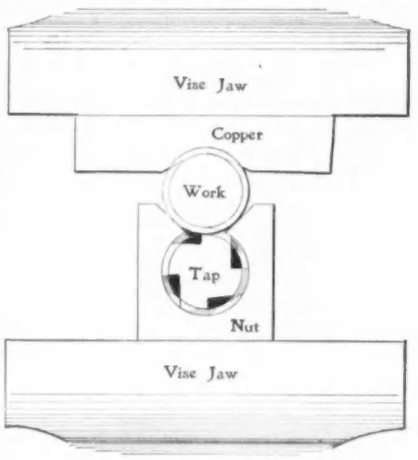


MACHINE FOR CUTTING ELLIPTICAL HOLES.

Emergency Rig for Cutting a Left-Hand Thread.

A writer in the "Blacksmith and Wheelwright" contributes the accompanying sketch of a way to cut a left-hand thread without a left-hand die. It is stated to be not new, having been employed a score of years ago by a steamboat engineer, who had a cylinder head knocked out, to cut some left-hand ⅝-inch bolts. We are quite unable to say why the engineer should have needed the left-hand thread under the circumstances indicated. The device and the way to use it are described as follows:

"When you want to cut a left-hand thread, take a right-hand tap of the desired number of threads and run into a nut hard and fast. Then take it out of the nut, and cut a V in the nut so that one edge of the tap will stick into the V after you put it back into the nut again. Turn the tap upside down, and have a piece of copper or some other soft metal against the vise jaw so that it will not spoil the thread on the work as the work is revolved. Put your nut and tap upside down and your copper (or other metal) in



CUTTING A LEFT-HAND THREAD.

the vise, and placing your work into the space between the V and the copper, turn your piece of work toward the left hand down in the vise, and you will get your left-hand thread. Care must be taken not to let the corner of the tap stick too deep into the V, as in that case you would break a piece out of the tap."

Fahrenheit intended 100 degrees on his thermometer scale to be the normal temperature of the human body, but missed it by about 1.5 degrees. The Centigrade scale is used in Europe and everywhere in scientific work.

Letters from Practical Men

Keeping Brass Work Clean.

Editor American Machinist:

I have been wasting—because I was unsuccessful—quite a lot of time lately in trying to discover or invent something that would be more unsuitable for handles, hand rails, push plates on doors and such things than polished brass. If anybody has anything worse to suggest it will be a surprise to me. When anybody is talking wisely about the survival of the fittest he should go lightly on brass door knobs. They have survived multitudinously enough, and I can't understand why brass is so persistently used in places where it self-evidently ought not to be, or why the enormous and absolute waste of labor involved in keeping brass work looking bright and respectable is tolerated.

This is saying nothing against brass work in its place. Bright and immaculate brass of tasteful and correct design is pleasing and satisfactory for decorative purposes, and nowhere more so than around machinery, but the trouble is that in so many places it is impossible, even with continual cleaning and polishing, to keep the brass looking decent. Some of it will be exposed to heat or to the flow of liquids or gases and be tarnished by that means, but much more will be exposed to the touch of the hand, and thereby become unsightly and the very reverse of beautiful or pleasing. For this latter how can there be any excuse? All are ready at once to express displeasure over tarnished and unsightly brass work, but too many bestow their blame in the wrong place. The person in charge is, of course, always held to be guilty, when the real blame should be bestowed upon the designer or constructor. When the engineer feels almost impelled to stick up signs reading "Keep off the brass," the only effective thing to do would be to compel the designer to "keep the brass off."

This applies to other things besides brass work. I have seen polished cast iron cylinder heads, with nuts and washers and stud ends, all originally equally bright, over which oil would be dropping or pouring, and burning on as soon as it got there, accumulating in spite of the most persistent wiping and scraping, until a most unsightly appearance was presented; and I, with some accumulated experience in this line, have had no feeling but pity for the engineer in charge, who was cheated in advance by the builder out of all of his legitimate right to pride in the appearance of his engine.

There are different ways of looking at this matter. I remember when the order went out to have all the brass work on the locomotives of one of the great railroads either removed or painted over, so that the enginemen would not have the work of keeping it bright, or, if they were not able to keep everything looking as it should, so that the engines would not attract attention by their disgraceful condition. Some thought the order a wise one, and some thought the reverse. It was quite generally argued that it must be demoralizing to take off the bright work, as it would not only be taking away what would keep the men busy, but would also remove a standing index and record of their industry, or the reverse. If the bright work was all kept up to the standard it might be argued that the man was evidently industrious and careful all through, and that therefore all the unseen, though more important, working parts of the engine must also be properly kept up and adjusted.

It would, perhaps, be easier to argue towards quite an opposite conclusion. The work on the engine might be divided into two very different classes. It might be so divided, consciously or not, in the mind of the engineman. There might be the useful and necessary work of caring for the operative mechanism in every detail of it, in wiping and oiling, in keying up and screwing up and adjusting; this would be the work which would invariably and reliably secure tangible results in better, surer, safer accomplishment; and then there might be the more or less useless, and the certainly hopeless, work which would have to do entirely with the external appearance of things, with the added discouragement, as regarded most of the brass, that things would not look very well after all was done. Now, it is expecting too much of human nature to think that both these kinds of work would be done with equal willingness. The faithful man who wanted to get all that he could out of his engine would do all of the first part of the work right up to the handle, while he might neglect the latter part without straining his conscience very much. Another kind of a man might keep a better-looking engine, but one that would be more frequently giving out, and that when running could not show as good results. In spite of the appearances, there could be little question as to which would be the most valuable man.

With me the presumption is all against a fellow who is eternally willing to keep on polishing brasses that other hands are continually soiling, or to do any work that, after all, is never done, except so far as that class of work is unavoidable. The work that does things so that they will stay done, and which are of value when done, is the true kind of work. Doing good work does a man good, but doing what accomplishes nothing—how can it be anything but demoralizing? It was a perfectly logical consequence, and nothing funny about it, that the fellow who could spend his time in "polishing up the handle of the big front door," and then in bragging about it, should have developed into the incompetent "Ruler of the Queen's Navee." If the handle of the big front door had been of bronze or of cast iron he would undoubtedly have developed into a different kind of a man, and the "navee" would have been different in consequence.

There is something really worth thinking about in the matter of the polished brass that is to be constantly touched by the hands, and that it is so hopeless to think of keeping clean and bright. There are so many things that could more satisfactorily take its place that it is idle to suggest them. It would seem that no change could be for the worse.

TECUMSEH SWIFT.

"Some Things That are Better Not Done"—Crane Hooks.

Editor American Machinist:

The diagram and table of proportions for chain, or crane, hooks published in the "American Machinist," No. 33, reminds me of an improvement, or change at least, my brother, William A. Sweet, has made in his formula for the construction of crane hooks, which consists in the addition of a new factor—a factor of convenience. He cuts off just about one-half of the up-turned end of the hook. This makes it infinitely more convenient to hook on a ladle full of melted iron or steel, and so long as 1¼-inch flange keeps railway trains on the track at full speed, why need a hook with but 1¼-inch upturn be feared?

It was he who first had the courage to scoop out the stock in his steam hammer piston rods to stop their breaking, and he now cuts off the crane hooks to abate a nuisance. This is one of the many things where infinite pains are taken to do that which does not need to be done.

In this connection it may be well to point out another thing in which the utmost pains are taken to do that which ought not to be done, and that is the folding of letters and papers. How careful one's stenographer is to fold the ends of the paper exactly even before putting in the envelope, which is a perfect nuisance to the one who receives it, whereas, if she would take equal pains to have the ends unequal by ⅛ or ¼ inch, one's correspondents would live to call her blessed.

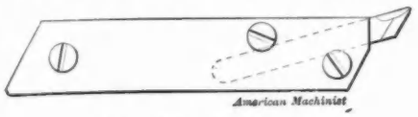
Syracuse, N. Y. JOHN E. SWEET.

A Simple Tool Holder.

Editor American Machinist:

The accompanying sketch shows another addition to the somewhat numerous family of tool-holders. It is made in halves fastened together with flat-head screws, an arrangement which leaves it free from all projecting parts. The two pieces have matched grooves for receiving the cutter, which is slightly thicker than the combined depth of the grooves, and is held by the tightening of the screws. It is intended to have the material of the cutter of a width or depth twice or three times the thickness, a shape which seems to be

better suited for the purpose than a square bar. If but little top rake is needed to the cutter, the grooves can be cut diagonally



A SIMPLE TOOL HOLDER.

the full length of the holder, allowing the use of steel in longer pieces. G.

How Jack Frost Got the Propeller off.

Editor American Machinist:

In the winter of '91—I forget the exact date—homeward bound from the Argentine Republic to Antwerp, we called in to discharge part cargo at Dunkirk, in the north of France. On getting out of Dunkirk we struck the stone pier and broke a propeller blade short off at the "boss," and half of another one. The propeller was four-bladed, cast in one piece, so, after limping round the coast and up the River Scheldt to Antwerp, orders came from the superintendent engineer to put into the dry dock and take the old propeller off and put on a spare one which we had stowed in the fore peak.

The repair work on an English steamer is always directly conducted by the second engineer, or, as we would call him, the first assistant, with the chief, of course, as an advisory committee of one, the chief's principal work being (on a tramp such as was our ship) to make nice indicator cards with a *templet* for the inspection of the "super," write out a list of stores, and abuse the poor second for not getting two weeks' work done in three days.

To return to my story. We got the balance of our cargo discharged and were duly warped into dry dock. The propeller, as near as I can recollect, was 12 to 14 feet in diameter, and had been on for several years. The taper pin, nut and washer were removed with considerable difficulty, but the propeller? We tried to pull it off; we rigged a swinging ram and tried to ram it off; we took out a length of shaft in the tunnel (shaft alley—American) and tried to pull the tail end shaft in; then we got a large sheet of iron and built a fire around the propeller to expand it, and went through the same program once more—but all to no purpose. Only one other course seemed left, and that was to cut the boss through on one side, from end to end, and wedge it off.

All this time, two days and a half, the Scottish chief was swearing in broad Lowland Scotch at dock gates, propellers in general and American second engineers in particular—which meant me. I had just about made up my mind to use the balance of the strength left in me to give that Scotsman a good old-fashioned Yankee licking and then send in my resignation, when a sudden thought struck me.

When in Germany I had seen the quarrymen on the Rhine going around in the winter time on top of the great basaltic cliffs and pouring water down in the cracks. The expansion of the water in freezing loosens these hexagonal columns of basalt, and in the spring time a few prys with a crowbar will send tons of stone thundering to the valley below.

For the benefit of those who are not up in marine work I may here mention that the propeller boss is chambered out in the center, and fits the tapered shaft at the ends only. The fire was put out at once and a man set to work to drill and tap a ¾-inch hole into the chambered part of the boss. While this hole was being drilled between two blades on top, another man was chipping a gutter ¼ inch deep from end to end of the propeller boss on the bottom. When the hole was drilled and tapped a similar gutter was chipped on the top side of the boss. We then made the lower block of a tackle fast to each side of the propeller and fastened the upper block to the mooring cleats on the quarter deck and chocked the falls. Then the chamber was filled with water and a ¾-inch bolt was screwed into the hole. This was possibly unnecessary, but was done to be dead sure. This job was finished about 4 P. M., and the hands knocked off, the propeller being still warm from the fire. At 8.45 P. M. Jack Frost got his work in, and both halves fell away from the shaft and hung by the tackles, and the fair name and fame of a Yankee second engineer was saved.

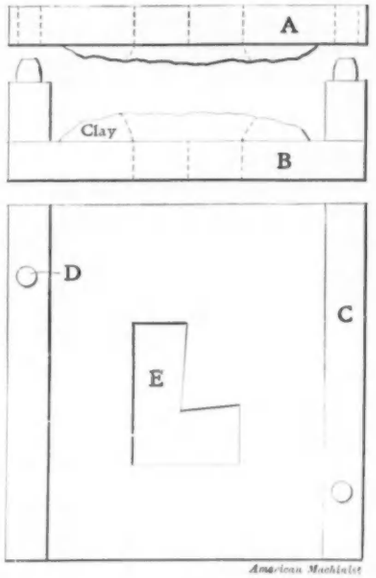
E. A. SUVERKROP.

Hardening Part of a Die—Slotting in the Shaper.

Editor American Machinist:

As you want your readers who appreciate your paper to send in their experience in machine work, etc., I hereby enclose a couple of points about work that I have gotten on to, and which have helped me to do the work quicker and better.

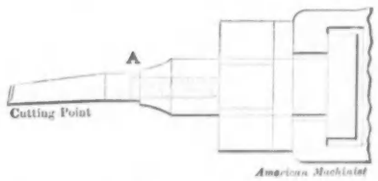
I had the other day a blanking die to harden. It was about 4 inches square and ½ inch thick, and was to be placed in a kind of a sub-die; therefore I had to drill and tap some holes in it for locating it on the base plate after it was hardened and the punch was fastened in its place in the upper part. In order to shear and fit the punch in the die quickly I needed the die hard around the hole; so I proceeded as follows: I took two pieces of 1-inch board, 9 inches square *A* and *B*, and nailed on two strips *C*, 1x1½ inch, drilled two dowel pin holes *D* and put in dowels, to enable me to put them together quickly and the right way, cut out hole *E* in both pieces, a little larger than the hole in the die, placed a layer of clay on one and pressed the die down into it, heated the die a little and put it again in the clay form to heat and dry it a little, then placed a ¾-inch layer of clay on the other board and pressed it down on the first board and the die, letting the dowels guide the board, and left it to harden a little while. Then I took them apart, and with a knife cut out the clay around the hole *E*, heated the die to the proper heat for hardening, put it quickly in the clay form, put the top board on, immersed it in salt water, and forced the water through the die by moving it up and down, held it horizontally for a few seconds, and then placed it in clean water to avoid roiling my salt water bath with clay. It took a minute or two before it got cold through. The cutting part of the die was very hard, but one of



FOR HARDENING PART OF A DIE.

the holes was drilled and tapped less than 5-16 inch from the same. It was surely not as soft as annealed steel, but soft enough to work with care.

I have seen at different times interesting and novel ways of doing slotting work or planing different shaped holes in large plates and dies in a shaper or planer, but I have seen no mention of a method employed by me occasionally, which works very nicely on my kind of work, as the tool is very stiff and rigid. I take a piece



TOOL FOR SLOTTING ON THE SHAPER.

of tool steel ⅝ or ¾ inch square, 3 to 5 inches long, depending on the work in hand; cut a thread on one end to fit the tool post of the shaper in place of the tool post screw, and put a nut on the threaded end to enable the blacksmith to hold it without marring the thread. It is then forged into a diamond-point shape, flat

or as a slotting tool, as the need may be, hardened, ground, placed in the tool post and screwed tight with a short piece of steel in the place of the tool ordinarily in use. Part at *A* is left square for the wrench. The work proceeds without springing or chattering.

TOOLMAKER.

Hints on the Design of Drill Jigs and Milling Fixtures.

Editor American Machinist:

Mr. S. F. Arthur, in his article entitled "Jig Designing for Low Cost of Jigs or for Low Cost of Work," in No. 16 of the "American Machinist," says he wonders "if there is any one branch of the machine business that requires more thought, broader experience and wider knowledge of shop operations and conditions than the making of jigs and fixtures." And the writer, after twenty years' shop experience in the positions of apprentice, tool maker, draftsman and foreman, is inclined to think that there is not. And in these days of strong competition and the ever growing tendency in some lines of manufacture toward the employment of the lowest priced help that can be found, there certainly is no branch of greater importance. And it might be added, none in which the first principles seem to be so little understood. Examples of jig and fixture designing are continually to be met with where some of the most important factors seem to have been entirely lost sight of or persistently ignored.

Every draftsman who is called upon to scheme up a set of tools for some given purpose probably will not possess the broad experience and wide knowledge of shop operations and conditions so essential in this branch of work. And to those who do not, a statement of the chief factors involved and a few hints may be of value.

The most important factors to be considered, and to be considered in every case, are: The course the work shall follow in the shop. The work must be quickly, easily and accurately located and secured. Convenience in keeping the locating points for the work free from chips and dirt. Tools should be self-contained. Class of help who will use the tools. Tools should be convenient for the operator.

As the relative value of these factors changes with the conditions under which they are considered, I have made no attempt to arrange them in the order of their value. But the first thing to be considered is the course the work shall follow in the shop.

Given, a part of a machine, and required the tools for its production. In this case we will suppose that there are holes to be drilled in the piece and milling cuts to be taken upon it. The question is, shall it be milled first and then drilled, or shall it be drilled first and then milled?

As a rule, it is better to do the milling first. Probably in nearly every case in which there are holes to be drilled and milling cuts to be upon the same piece of work, it is desired that these holes and milled surfaces shall bear a certain definite relation to each other, and, whatever the limit of variation allowed, more accurate work can be got with less care and attention, and consequently at a lower cost, where the holes are drilled from a milled surface than where it is attempted to mill this surface from the holes. But in order to decide this question, a "working point or surface" must be determined upon.

In each part of every machine there is always some one point, it may be a hole, or a lug or boss, or a plane surface, or a slot, which, from its position in the completed machine, should be taken as a "working point," or point to work from and refer to in all the operations necessary to produce that particular piece.

Then it follows that the working point is the first part of the piece to be machined, or we will say, it is a part to be machined at the first setting of the work in the jig or fixture. And this point once obtained should be used to locate the work in the different jigs and fixtures for all the subsequent operations. It is bad practice to change a working point; performing one operation from one point and another operation from another point is not apt to give very good results.

With punched blanks, good drop forgings and all turned work the contour is such that it is generally an easy matter to hold them by some part of their outline in very simple milling fixtures and make the first operation a milling cut. But with castings, from their lack of uniformity, etc., it would mean in many cases complicated fixtures and the exercise of a great deal of care and judgment in setting the work. But if the drilling is done first, and it is considered that the holes instead of the outline of the piece may be used in locating and securing the work, it will be found at once to simplify the fixture and to lessen the cost of the operation. But whichever course is decided upon, the tools should be such that all the operations of one class can be completed before those of the other class are commenced. Keeping the work traveling back and forth between the drill press and the milling machine is not conducive to economical production.

The work must be quickly, easily, accurately located and secured. In regard to these factors it is difficult to say as much as their importance demands, for all the difference between accurate work at a low cost and accurate or inaccurate work—it is as likely to be the one as the other, though the chances are in favor of the inaccurate—at a higher cost, depends upon their being thoroughly considered and intelligently provided for.

The various methods commonly used for locating and securing the work in jigs and fixtures, such as by set screws, clamps, cams, bunters, spring-pins, slip-wedges, etc., are familiar to most draftsmen, and any attempt to lay down a rule for general use in their application would result—from the exceptions—in a rule to fit a special case.

Convenience in keeping the locating points for the work free from chips and dirt should be looked after. That this is one of the conditions essential to the accurate and rapid production of work from jigs and fixtures it would seem must be evident to anyone at all acquainted with their use and object. But cases are frequent in which the designer has—seemingly—paid no attention to this point.

Tools should be self-contained. By this is meant that all the means necessary to locate and secure the work should be component parts of the tool. The operator should not be obliged to use a hammer, screw-driver, wrench, or any other implement in order to secure the work. Neither should it be necessary to remove any of the parts of the tool for the insertion or removal of the work. With large work these conditions cannot always be met, but they should be always considered.

Class of help who will use the tools must be considered. In a general way it can be said that one of the objects of the use of jigs and fixtures is to reduce two of the "human factors" in the production of manufactured articles—skill and intelligence—to their lowest possible terms in so far as the actual producer is concerned, and consequently in designing these tools the designer should exact as little in the way of skill and judgment from those who are to use them as he possibly can. In a good many instances this would mean very expensive tools, both in design and construction, for where unskilled labor is one of the "shop conditions" and "good work" one of its requirements—such cases are not at all rare—problems frequently arise that can be satisfactorily solved only through the medium of expensive tools. In cases where the class of help employed is such as can be depended upon to exercise a little skill and common sense when it is desirable that they should, it is often advisable to take advantage of this, and provide tools at a lower cost.

Tools should be convenient for the operator. This is one of the factors essential to rapid production, and for its intelligent consideration the designer should imagine himself in the operator's place; his natural position at the machine should be known, and as many of the movements necessary in placing the work in the fixture, operating upon it and removing it should be done from that position as is possible. And it is well to remember that most machine operators have but two hands; that but very few of them are ambidextrous, and that any movements that seem awk-

ward and unnatural to the designer would probably prove so to the operator.

That there are other considerations to be taken into account in designing these tools the writer is well aware, but the intention of this article has been to state, in as few words as possible, the most important factors in such a way as to admit of general application.

E. H. DODGE.

Internal Combustion Engine Ignition

Editor American Machinist:

In the "American Machinist," No. 34, Mr. Fred C. Tygard says I make the mistake which quite a number of other writers make, in dividing the crank shaft revolutions of an Otto cycle internal combustion motor by 4, instead of by 2, to obtain the number of igniting effects required per minute. Mr. Tygard is quite wrong; I do not make that mistake. I am perfectly aware that with the Otto cycle one ignition is required for each four piston strokes, not for each four crank shaft revolutions. In the article to which Mr. Tygard refers I did make this blunder, as mechanics often blunder in perfectly familiar matters which call for no more than a passing thought. What most surprises me is, that this article was read with great care by Mr. Darling, Jr., of the United States Storage Battery Company, who is deeply interested in the application of his batteries to internal combustion motor ignition, and by Mr. Secor, of the Secor kerosene burning motor, as well as by one of the editors of the "American Machinist," and that none of these three gentlemen, all of whom are perfectly aware of the incorrectness of my figures, noticed the blunder.

I read everything I write for print three times over carefully, and how I could have passed my figures as correct I cannot tell, though it is not a strange occurrence for the one who makes an error in figures to pass that error repeatedly without detecting it, even while searching for the cause of what he knows to be an error in his final results.

I think Mr. Tygard is aware of some things of general interest to makers of internal combustion engines, and I, for one, would be very glad to read a fully detailed account of his experiences. I do not myself see how, with ordinary forms of engines, there can be any difficulty in obtaining any number of sparks per minute, provided sufficient current is available. I know very little from my own practice about charge ignition, but I do not think that 3,000 contacts and breaks per minute is anywhere near the limit of electrical possibilities, provided the supply of current is ample. I may say that the highest speed of my six-cylinder motor is 500 shaft-turns per minute, and that each of my cylinders, Otto cycle, requires one spark for each revolution of the shaft, making 3,000 sparks per minute, maximum. I trust Mr. Tygard will not think I make another blunder in this statement, which is, I assure him, quite correct. I have never seen an internal combustion engine running at 2,000 crank-shaft turns per minute, but this speed is asserted in journals of good repute.

Did Mr. Tygard write "Bran De Rochas," as he is printed in the "American Machinist," or "Beau" De Rochas, as is correct?

It is true that charge ignition is one of the important and not yet fully answered problems of the internal combustion motor, and Mr. Tygard can aid in the matter by giving the mechanical details of his own experiments with sufficient minuteness to enable other constructors to profit by an accurate knowledge of what he has done. A mere statement of the well-known fact that charge ignition is not satisfactory is of little aid in this matter, but construction details of ignition mechanism, successful or unsuccessful, printed in these pages, would be a real help.

HUGH DOLNAR.

The Narrow Belt Dressing Patent.

Editor American Machinist:

An unsigned article printed in your issue No. 34 seems to be written under a wholly erroneous conception of the commercial use and value of patents having claims of narrowly limited scope, as the writer says, "The following is the entire 'claim' of the patent, and seems to make the document utterly worthless, for of course the slightest departure from the schedule of ingredients would evade it."

The patent in question covers only one fixed combination of materials, asserted to produce a good belt dressing, and is, as written, so narrowly limited by the wording of the single claim allowed, that practically the same belt-dressing composition can be produced without infringing this claim.

Now does this narrowness of claim make this patent "utterly worthless" in a commercial sense? Most decidedly not. In point of fact, the initial chances of making some money without much outlay or uncertainty, by the use of this narrow belt dressing patent, are far more rosy than with a patent covering a real advance in an important art broadly.

With this belt-dressing patent, which is simple to the point of seeming silliness, but under which I shall assume, for the purposes of this article, a belt dressing of practical usefulness can be produced, the road towards money-making is wide open and wholly clear of obstructions. There is no costly and heart-breaking experimental machine building in sight, and the public, or a large part of the belt-using portion of it at least, believes that belt dressings generally are of value, and is now paying a very large sum annually to belt dressing makers. The market is open, is constant and the demand is large enough to invite extensive operations, and under this narrow patent the product package can be honestly and fairly marked "Patented," just the same as if the patent covered the only usable belt dressing on the market. This gives that color of exclusive ownership of an improved article which makes the word "Patented" an aid in selling a manufactured product, and puts an imitator, even though he offers substantially the same article for sale, at a great disadvantage. Supposing manufacture to be begun under a patent of narrowly limited claims, the product meeting with favor from purchasers; there will be no imitators or infringers until the sales reach considerable magnitude. These infringers or imitators, when they do come, cannot be restrained by the courts, because the patent is too narrow to go to law with. But, starting with the narrow but certain foothold given by the original valid patent, the first maker of this belt dressing has obtained vogue in the market, which is the most valuable, commercially, of all trade properties. The label is a proper subject for protection by copyright, and providing always that the article produced is so good as to command repeated orders from the same buyers, the narrow patent serves every commercial purpose just as well as if it were broader.

In point of fact, the whole life of a patent covering much original matter is very likely to be spent in costly and non-money-making efforts to educate the public up to its use, as witness Watt's steam-engine patents, which expired without paying Boulton and Watt their money outlay back again, and many thousands of other exploiters of really new and really good patented inventions, covered by valid patents of wide scope, with some of whom almost every person having to do with matters mechanical is personally acquainted.

JOHN RANDOL.

Chart for the Mechanical Solution of Right-Angled Triangles.

Editor American Machinist:

When submitting the chart for the mechanical solution of right-angled triangles, I claimed nothing radical, but never having noticed it in technical journals nor seen such metal instrument, as Mr. Cox mentions, I concluded it must be of great value for the practical purposes of your readers.

An oblique triangle, when one side and two angles are given, can also be solved, by dividing the triangle into two right triangles and then proceeding as explained in your issue No. 32.

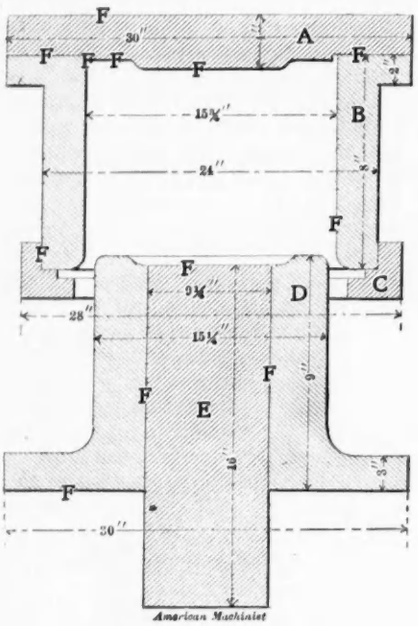
JOHN M. B. SCHEELE.

Saving Expense on Pattern Work.

Editor American Machinist:

I have noticed quite a number of articles in the "American Machinist" lately about the making of cheap patterns for single special jobs in the foundry. I send herewith a sketch of a set of formers for a

flanging press which we made quite recently. The cost of complete patterns made in the regular way would have been about $25. Instead of that, the rig we used involved three hours in the pattern shop and about two hours' extra work in the foundry. Of course such a saving as this



A CHEAP PATTERN JOB.

would only be possible where they have the appliances. A small shop or a new concern could not have done it.

Referring to the sketch, it will be seen that four patterns were required. The top former *A* was made from an old piston pattern. The female former *B* was made by using a 16-inch and a 24-inch pulley ring for the inside and outside, respectively, with a segment 2 inches thick to make the flange. For the clamping ring *C* a segment was made about one-sixth of a circle, of the section as shown. The male former *D* was made from a 16-inch pulley ring, with a segment 3 inches thick for the flange and using a standard 8½-inch core for the center. For the central ram *E* we found an old pattern all right in the pattern loft. M.

Pattern shop of Fraser & Chalmers, Chicago.

Repairing a Fusible Plug at Sea.

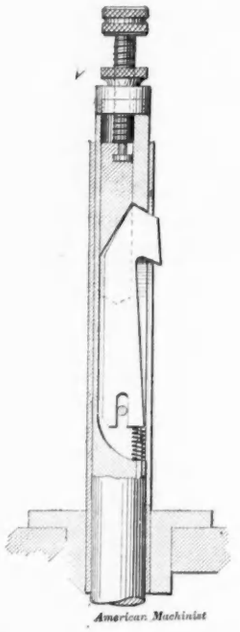
Editor American Machinist:

Your correspondent, E. A. Suverkrop, describes how much trouble he was put to in repairing a soft plug in a mail steamer. Why did he not take a round file in a pair of tongs, drive it in and break it off without troubling to let out the water, as has often been done in locomotive service.

ROBERT BRYN.

Setting Out the Tool in a Key-Seating Machine.

The cut shows a recently patented device for setting out the cutter of a key-seating machine so that it may take successive cuts until the required depth of key seat is obtained. The cut will, of course, explain itself to others as it did to us. The cutter, of the proper width for the key-seat required, sets in a slot in the round vertical bar. The lower end of the cutter is provided with an open slot which fits over a cross pin fixed in the bar and serving as a pivot. Under the front corner of the cutter is a spring which keeps the cutter constantly thrust upwards, so that its upper front corner bears against a bevel surface at the periphery of the bar, so that there is no slack to the cutter or lost motion when the cutting occurs. This bevel bearing at the upper corner, in connection with the action of the spring, also keeps the cutter always drawn backward



FEEDING OUT THE CUTTER ON A KEY-SEATING MACHINE.

against the wedge by which it is fed outward. This wedge is operated by a milled head screw extending up through the end of the bar. As the wedge is moved downward by the screw the cutting edge is, of course, fed outward from the bar. A jam nut on the feed screw may be used if required.

Progressive Spain.

We have heard a good deal during the past few years about the unprogressiveness of Spain, but it would seem that there are some people there who do not hesitate to make a radical change when it seems as though there might be good reason for it.

Vice-Consul Reed, at Madrid, has informed the State Department that, by a decree, time in Spain is hereafter to be counted from 1 to 24 hours, the order to go into effect January 1, 1901, the day to begin at midnight. The interval between midnight and 1 o'clock will be designated by a cipher, and the number of minutes as 0.05, 0.59. The government offices, telegraph, telephone, railroad, steamship lines and all public offices are to observe the new method.

The new method is better, and we wonder how long it will be before our progressive American spirit will lead to its adoption here.

Crane Hooks.

A correspondent referring to the article under the above title in our issue No. 33, finds some of the letters on the diagram ambiguous, and asks their exact meaning, and we give the following in answer:

D is the radius of the upper left-hand quadrant.

E is the radius of the lower left-hand quadrant, and is struck from the intersection of the horizontal center line with the vertical line *F*.

F is the radius of the lower right-hand quadrant and is struck from its intersection with the horizontal line near its top.

V is the radius of the left-hand end of the horizontal section corresponding to *S* at the right-hand end.

Questions and Answers.

Name and address of writer must accompany every question. Questions must pertain to our specialties and be of general interest. We cannot undertake to answer by mail.

(19) A. E. H., Bay City, Mich., sends the accompanying sketch, in which $P D$ = pitch diameter of a worm wheel at center section; $p d$ = pitch diameter of a worm wheel at end section, and says: (1) It is obvious from the sketch that $p d$ is greater than $P D$, and since the number of teeth remains the same, the pitch at the end of the tooth must be greater than the pitch at the center section. At the same time the pitch of the worm at points *a* and *b* is the same. Are not these two facts contradic-

(*Continued on page 45.*)

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Gear Wheels, gear cutting. Grant; see p. 22.

Dies & punches. Amer. Hdw. Co., Ottawa, Ill.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Forming lathes. Mer.Mach.T.Co.,Meriden,Ct.

Punches & dies. Wal.M.Wks.,Waltham,Mass.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Book "Dies and Diemaking," $1, post paid. J.L.Lucas,Bridgeport,Ct. Send for index sheet.

F. J. Stokes Machine Co., 13th and Noble sts., Philadelphia, Pa., build light machinery.

Wanted—Copy of "American Machinist," No. 52, Vol. 20. Address Box 270, AM. MACH.

Selden Packing for Stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., New York.

First-class parties want to hire a modern machine shop: gas belt preferred. Address Box 243, AMERICAN MACHINIST.

For Sale—One second-hand Backus gasoline engine, 25 H.-P.; used about 3 months. Address H. M. Williams & Co., Attleboro, Mass.

Threads and gears; easy rules to cut any

thread possible to be cut in the lathe, without algebra, sent to any address for 25c. by G. W. Dixon, Spring Lake, Mich.

Institutions retiring from business having machine tools, brass and wood working machinery will find it to their interest to correspond with us. We purchase complete plants or handle them on com. C. C. Wormer Mach. Co., 55-59 Woodbridge st., W., Detroit, Mich.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents.

Situations Wanted.

As draftsman or machinist seek position. Box 266, AMERICAN MACHINIST.

Practical mechanical engineer, 28, desires responsible position; best references. Box 271, AMERICAN MACHINIST.

Mechanical engineer, 14 years a practical mechanic, up to date, energetic, desires position as foreman or general foreman. Box 272, AMERICAN MACHINIST.

Superintendent: 8 years' experience as designer of machinery and superintendent of factories; up to date in shop practice; successful in handling men. Box 274, AM. M.

Position as superintendent in plant manufacturing light interchangeable metal work; 20 years' experience brass work, sewing machines and bicycles. Box 257, AMER. MACH.

Foreman machinist, competent to devise special machinery and tools for manufacturing purposes; middle-aged Westerner; technical, practical and up to date. Box 263, AM. M.

Wanted—By an Eastern toolmaker of ability, a position at model and light tool or automatic and labor-saving tools; Chicago direction preferred. Address Box 273, AM. M.

Skilled designer of special and standard machine tools and jigs will be open to engagement October 1; experienced as chief draftsman and assistant superintendent. Box 268, AMERICAN MACHINIST.

Foreman toolmaker and stock-keeper wishes to advance; wants position as assistant superintendent; will make no promises; let results do the talking; I will work. Address Box 269, AMERICAN MACHINIST.

Situation as foundry foreman; engine, sawmill, chemical or copper-works castings; sober, steady; member of Philadelphia & American Foundrymen's Associations. Address "Tubal Cain," AMERICAN MACHINIST.

Partner Wanted.

THE advertiser wishes to establish a large well equipped plant for the manufacture of machine tools for the American and foreign markets, and wishes to associate himself with a capable business man able to contribute at least $100,000, and who would be able to take the financial management. The advertiser at present controls work sufficient to keep 250 men employed, a large part of which can be turned over to the new company. It is the advertiser's intention to take advantage of all the latest developments in manufacturing methods and to establish a plant unsurpassed for efficiency of production.

Address T. B. M.,
care The American Machinist.

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W. R. SAWYER, Lessee.
86 Seneca St.,
Cleveland, Ohio.
GEARS of all descriptions.

Assistant engineer or head draftsman; M. E., Cornell; 32; married; general lines, especially excavating machinery and cranes; specialties, office methods, standardizing and use of head. Address Box 265, AMER. MACHINIST.

Anyone wishing a practical machinist and toolmaker, experienced on high-grade heavy and small interchangeable machinery, with A1 references as to ability to fill a responsible position, address Box 267, AMER. MACH.

Wanted—Position as chief clerk in reliable iron works or machine shop, by young man of experience in iron business; familiar with shop methods, costs, etc.; wants change of location; best of references from present employers. Address "Western," care AM. MACH.

All-round mechanic, 40 years old, and for past 14 years with only two concerns, as superintendent, wishes a position where thorough mechanical training and ability to handle men will count; well posted on rolling-mill, wire-mill, mining and similar heavy machinery; will go anywhere; member A. S. M. E. Address Box 264, AMER. MACHINIST.

Help Wanted.

Draftsmen desiring extra money, state where employed, confidential. Edwin Guthrie, Corcoran Building, Washington, D. C.

Wanted—Draftsman and designer for a machine-tool building concern located in New England. Address Box 261, AMER. MACH.

Wanted—Machinist and draftsman; one familiar with paper-mill machinery preferred; state experience and salary. W. M., care AMERICAN MACHINIST.

Wanted—8 or 10 first-class general machinists; those with some experience on tool work preferred; in answering state age and wages wanted. Box 262, AMERICAN MACHINIST.

Wanted—Draftsman, experienced in design of machine tools and automatic machines. Address, stating age, references and salary expected, The Yale & Towne Mfg. Co., Stamford, Conn.

Wanted—2 or 3 good machinists for machine shop building hoisting and haulage engines. State age and experience fully, whether machine or floor or vise hand, to Box 259, AMERICAN MACHINIST.

Wanted—3 or 4 first-class patternmakers; write, stating experience, age and salary required; none but first-class workmen of good habits desired. Address Farrel Foundry & Machine Co., Ansonia, Conn.

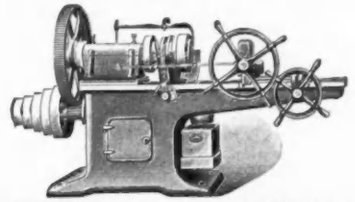
Wanted—Blacksmith, first-class mechanic, who understands forging on anvil and under steam hammer, for machine shop making general forgings. State age, experience fully to Box 260, AMERICAN MACHINIST.

We are enlarging our works, and will shortly require an increased number of skilled mechanics; we invite application from pattern makers, molders and machinists. Address the Westinghouse Machine Company, East Pittsburgh, Pa.

Machinist—By firm in Pittsburgh, Pa., good, all-round machinist; must be first-class lathe hand and understand tool and die work; give experience, age, salary expected, and whether married or single. Address J. D., care AMERICAN MACHINIST.

Wanted—A pattern-shop foreman for large machine shop in New England; an up-to-date man, of good habits, familiar with heavy work, gearing and general transmission machinery. Address, giving age, experience and salary expected, Box 251, AMER. MACHINIST.

Wanted—25 good vise hands on light machine work; only good, steady men need apply; to such, good pay and permanent positions are offered; state age, wages now received, where you have been employed, whether single or married. American Machine & Foundry Co., Hanover, Pa.



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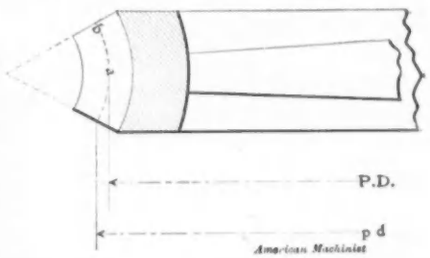
(*Continued from page 44.*)

tory, since, if the wheel fits the worm at point *a*, it could not fit the worm at point *b* if the pitch of the wheel is greater at *b* than at *a*? A.—In point of fact, the worm does not fit the wheel at *b*. Remember that the wheel is cut by a hob which is a duplicate of the worm, and this hob, in the nature of things, cuts the wheel so that the two will mesh. The increased speed of point *b* over *a* results in the spaces cut being wider at *b* than at *a*, and when the worm and wheel are placed in gear the contact is theoretically only at *a*. Practically, the tangency is so close that the



contact is more than a point, but if the wheel has much width, it does not extend clear across the face. This whole subject of worm thread contact is a much deeper one than is generally supposed. On the Hindley worm, for instance, no one seems to know just what the contact is. (2) Is there a method of laying out a correct end view of a worm-wheel tooth? A.—Not that we know of. The profile is very complex at this point, and an axial view would be still more so.

(20) C. A. J., Everett, Mass., asks (1) How does the efficiency of compressed air for driving machines and factories compare with that of the steam that compressed it? A.—The mechanical efficiency of compressed air as usually employed is very low. When used in small engines, without special devices for securing economy, it does not probably give back over one-third of the power consumed in producing it. Compressed air is employed because of its adaptability to its purposes, which outweighs its low efficiency. (2) How does the efficiency of compressed air compare with that of electricity? A.—Very unfavorably, though the two agents are not, properly speaking, rivals. Each is applied to work to which it is, on the whole, best adapted. Compressed air could be made to do much of the work done by electricity, but electricity could not well be applied to most of the uses with which compressed air is identified. (3) Would any economy result from a live steam jacket applied to a rotary engine having a cut-off? A.—Practically no. Rotary engines are so extravagant in the use of steam that any slight gain due to a steam jacket would be lost sight of in the general result. (4) Assuming no clearance loss, can a rotary engine gain as much power as is required to give momentum to the piston, cross-head, etc., of a reciprocating engine? A.—There is no such loss in

reciprocating engines as you name, and a rotary engine would have no advantage over a reciprocating engine in that respect. The only advantage of a successful rotary engine over the reciprocating type would be in its compactness, simplicity, etc. (5) Would there be any gain in the economy of a steam engine if the cylinder were fitted with a dead air space containing pipes through which the exhaust steam was passed? A.—No; but rather the reverse. Exhaust steam is colder than the steam in the cylinder, and it would tend to cool the cylinder and condense the steam in it. In all high-class engines it is the aim to get the exhaust steam away from the cylinder as soon as possible.

Examination for Position of Mechanical Draftsman.

The United States Civil Service Commission announces that on September 25, 26, 27, an examination will be held in any city in the United States where it has a local board of examiners for the position of mechanical draftsman, with expert knowledge of design and construction of hydraulic dredges.

Applicants must furnish *prima facie* evidence of practical experience in the design and construction of hydraulic dredges before they will be permitted to enter the examination. Age limit, twenty years or over.

Persons who desire to compete should at once apply to the United States Civil Service Commission, Washington, D. C., for application forms 304 and 375, which should be properly executed and promptly filed with the commission.

Personal.

Mr. A. E. Kinney, who has been from the beginning and until very recently the editor of "Compressed Air," recently gave an interesting lecture on compressed air at the Catholic Summer School, Plattsburgh, N. Y. The lecture included a series of experiments illustrating the application of compressed air.

Obituary.

Simon P. Kase died in Philadelphia, August 26, eighty-six years old. Col. Kase, who was a native of Pennsylvania, left home when he was twenty years old and began building threshing machines, in which he was successful, and in 1835 he established an agricultural and machine shop in Lebanon County. In 1837 he started an iron foundry in Danville, Pa., and in 1844 he built a rolling mill for merchant iron. A force pump invented by Kase brought him a large amount of money. He later became a railroad man and built several railroads, and was involved in an interminable lawsuit with the Pennsylvania Railroad.

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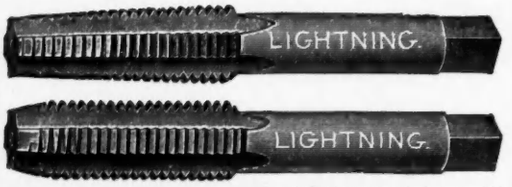

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